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[OFFICIAL NOTICE.]

Wrinkle Department, Western Gas Association.

WESTERN GAS ASSOCIATION,
OFFICE OF EDITOR, WRINKLE DEPARTMENT,
MILWAUKEE, WIS., Oct. 25, 1905.

To the Members of the Western Gas Association: The next meeting of the Western Gas Association will in all probability be the last one, owing to the proposed merging of the three leading gas associations. Therefore, every effort should be made to make it a rousing success in all respects, and it falls to my lot as Editor of the Wrinkle Department to again appeal to you for this department. I earnestly request those who have made promises of contributions to remember such as soon as possible, and I fully expect to hear from quite a number who have not made any promises, but who I know are in possession of something that would prove of value to the Wrinkle Department.

Yours very truly, B. MCADAM, Editor.

[NOTICE.]

Wrinkle Department, Ohio Gas Light Association.

OHIO GAS LIGHT ASSOCIATION,
OFFICE OF THE WRINKLE DEPT.,
719 CITIZENS BUILDING,
CLEVELAND, O., June 13, 1905.

The Wrinkle Department of the Ohio Gas Light Association is now ready to receive contributions for the 1906 collection, and a sketch or description of all devices, formulæ and methods of accomplishing objects pertaining to the gas business, is respectfully solicited.

Please send a written explanation, accompanied by any sketch, photograph or drawing, to the above address, or a description alone will suffice.

Hoping to receive prompt compliance,

Yours very truly, W. E. STEINWEDELL, Editor.

BRIEFLY TOLD.

BEGINNING IN A SENSIBLE WAY ON THE SURFACE.—According to the New York *Sun* of last Friday the State Commission of Gas and Electricity will hold a hearing in the Council Chamber, New York city, on the 20th inst., for the purpose of investigating the complaints made to the Commission as to the price and quality of gas supplied by the Consolidated Gas Company in the boroughs of Manhattan and the Bronx, and the Brooklyn Union Gas Company, operating in the borough of Brooklyn. The investigation will consider the methods employed by the various Companies in the transaction of their business and the methods and means employed in the manufacture and distribution of gas for light, heat and power. At the close of the investigation the Commission is empowered to order such improvements as will "best

LIBRARY OF CONGRESS

promote the public interests, preserve public health and protect both the users of the gas and those who are employed in its manufacture." Complaints have been filed with the Commission by the firm of Page, Brant & Booth and by Clarence J. Shearn, as attorneys, asking for a reduction in the price charged for gas by the Companies. In each case the attorneys have submitted petitions signed by 100 consumers of gas. In the petitions filed by Page, Brant & Booth the Commission is asked to fix the price at 75 cents per 1,000 cubic feet. Shearn's petition asks the Commission to fix a price warranted by the evidence. The Commission has general supervision of all persons and corporations having authority under general or specific law to lay down or erect and maintain wires, pipes and other fixtures in any city of the State for the purpose of furnishing light, heat or power. It may investigate the price, quality and pressure of gas or electricity at any time it sees fit. As to price the statute says that the Commission, "within the limits prescribed by law, may fix the maximum price of gas or electricity which shall be charged by such corporation or person in such municipality." The legal maximum to private consumers in this city is $1 and to the city 75 cents. The Commission is composed of Frederic E. Gunnison, Chairman; John C. Davis and Lucian L. Shedden, with Thomas D. Hoxsey as Secretary. The Companies to which notices have been delivered are the Consolidated, Standard, New Amsterdam, New York Mutual, Central Union and the Northern Union Gas Companies, all of Manhattan, and the Brooklyn Union Gas Company, of Brooklyn.

NOTES—

"F. C. S.," writing from Moline, Ills., under date of the 7th inst., says: "Dear JOURNAL: Wonder of wonders! A Gas Company at Galva, Ills., operating "one bench" of 4's, is using a charging machine. It consists of a "billie goat" tied to the gate post!

AT the annual meeting of the Capital City Gas Company, of Montpelier, Vt., the officers elected were: Directors, Fred. Blanchard, A. C. Blanchard, J. W. Lamb, E. H. Demilt and G. L. Blanchard; President, Fred. Blanchard; Vice-President, J. W. Lamb; Treasurer, E. H. Demilt; Superintendent, W. C. Bill. The latter succeeds Mr. Benjamin P. Bill, who resigned that post in order to assume the duties of a responsible position with the Springfield (Mass.) Gas Light Company.

THE Mount Clemens (Mich.) Company has rented handsome and commodious office quarters in the Pequignot Building on Front street. Manager Davis invites any gas man who has occasion to visit Mount Clemens on one account or another to look him up.

MAJOR JOHN BYRNE, a Director in the Detroit (Mich.) Gas Company, died in Larchmont, N. Y., the night of the 31st ult. He was in his 60th year, having been born in Maryland, Nov. 12th, 1845. At the time of his death he was President of the Pittsburgh, Shawmut and Northern Railway, and a Trustee of the Emigrant Industrial Savings Bank of this city.

THE Board of Gas and Electric Light Commissioners has been petitioned by certain residents of New Bedford, Mass., to order a hearing to determine whether or not the rates charged for gas and electric currents by the New Bedford Gas and Edison Company shall be reduced.

SUPERINTENDENT PETTIBONE, of the Westfield (Mass.) Gas and Electric Light Works, has advised the Selectmen that it seems feasible to order a reduction in the selling rate for gas. At present the net charge is $1.50 per 1,000, and it looks that in the readjustment the figure will go to $1.30. It is a municipally owned concern.

THE offices of the Mattoon (Ills.) Gas Light and Coke Company are now in the Virginia building on Broadway.

A CABLE dispatch from Munich, Germany, says that Prof. Korn, a leading electrical inventor of that city, claimed in a lecture before the Eletrotechnical Association that the problem of transmitting photographs by telegraph had been solved in principle, and it was now possible to transmit a photograph or sketch 6 inches square in from 10 to 20 minutes. This was done over a telegraph line between Munich and Nuremberg, but was equally practicable over 5,000 miles. The photograph to be transmitted is placed in a transparent glass cylinder which revolves slowly, at the same time moving from right to left. A ray of electric light is thrown upon the cylinder and lens, and when the ray reaches the interior it is brighter or darker, according to the coloring of that particular part of the photograph through which it passes. Inside the cylinder is some selenium, which transmits an electrical current in proportion to the intensity of the light brought to bear upon it. This selenium is connected with a wire over which the photograph is transmitted,

Taxation of Gas Companies.

[A paper read by MR. GEORGE MCLEAN, of Dubuque, Ia., at the Thirty-third Annual Meeting, American Gas Light Association, Milwaukee, Wis., Oct. 18-20, 1905.]

The forms of taxation applied to gas companies and other public service corporations in the United States, or to which it is supposed to subject them, are:

1. The *ad valorem* or general property tax, such as applies to tangible property generally in all the States.

2. The income tax, imposed in the form of a tax on gross earnings by the municipality, or State, or both. It is rarely proposed as a substitute for the *ad valorem* tax, but more commonly as an addition thereto.

3. The franchise tax, intended to deny the public service corporation the benefit of the custom or law whereby the assessor exempts the business of the ordinary corporation, individual or firm and assesses only the physical property used in the operation of that business.

4. The excise, or occupation tax, which is additional to the *ad valorem* or general property tax, and is levied against occupations such as saloon keeping, which are supposed to be injurious to society and in need of suppression, restriction or special regulation.

Appended to this paper is a table showing the States which levy or authorize taxes on the gross earnings of public service corporations as an addition to the *ad valorem* tax or as a substitute therefor.

The courts have decided that the State has the right to subject the public service corporation to the franchise tax. The most recent decision to this effect was given by the Supreme Court of the United States during the present year in passing upon the cases arising under the franchise tax law of New York. Justice Miller, in rendering a decision by the same tribunal years previously, said that the franchise was a part of the property liable to the *ad valorem* tax, and he declared the value of the franchise to be the value of the corporation's stocks and bonds over and above the value of the physical property used in the operation of the business.

Some States have adopted this rule of measurement in providing for what they call the franchise tax, and for what the Supreme Court of Ohio calls the excise tax and likens to the excise or occupation tax against the saloon keeper, who pays it in addition to the *ad valorem* tax on his goods and his bar equipment.

Under an ideal system the public utility would be taxed by the municipality alone and on the basis of gross earnings. It would not be taxed by the township, school, county and State government if owned and operated by the municipality. Furthermore, the gross earnings rule would apply to all, while the rule laid down by the laws of some States for ascertaining the franchise value—the value of the stocks and bonds over and above the value of the physical property—is one which obviously cannot be applied when the physical property is owned by an individual or firm.

But to elaborate upon a gross earnings as a substitute for the *ad valorem* tax would be a waste of time, because a condition precedent to such substitution in most States would be the adoption of a constitutional amendment, and this change in the organic law could not be procured in the present state of public sentiment. Iowa is one of the States in which a constitutional amendment would be necessary. Our State taxed railroads on gross earnings only until 1872, when the Supreme Court declared this plan contrary to the constitution of the State. It does not appear, however, from any decisions of the courts that the Legislature is without power to authorize a tax on gross earnings by the State or municipality as an addition to the *ad valorem* tax.

A fact which the public service corporations should look in the face is the existence of a growing sentiment in favor of the franchise tax. Its constitutionality has been affirmed by the highest court in the land. The law provides for it in Iowa, but in Illinois is not enforced. Its enforcement, if attempted, would probably be resisted, not on the ground that the State is without authority to tax the public service corporation on the entire value of its property, nor to accept the market price of stocks and bonds as a measure of value, but on the ground that the entire assessment for city, county and State has been vitiated by fraud. For instance, the assessor often finds it convenient for him and advantageous to the public treasury to adopt one form of assessment when the law prescribes another. The law provides for assessing certain stocks to their individual owners, but some of them may be non-residents and all of them are entitled to deduct their debts, a privilege they would be certain to exercise if pursued by the assessor. He, therefore, agrees to a compromise whereby the association itself pays taxes on a certain valuation. The compromise serves the convenience of the assessor and

the interests of the public treasury, but it is unlawful and, therefore, a fraud in the eyes of the law. Again, the city council frequently exempts new enterprises, or agrees that the valuation thereof for a certain term of years shall not exceed a certain sum. These exemptions may be approved and even demanded by public sentiment, but they are unlawful, and Judge Dillon in his work on "Municipal Corporations" declares that illegal exemptions are frauds which vitiate the entire assessment.

However, the law is a poor reliance against injustice, inasmuch as its administration is in the hands of courts which, in the language of Mr. Dooley, "Follow the election returns." Mr. Dooley had in mind the Supreme Court's decisions in the insular cases, rendered after the people at the polls had apparently returned a verdict in favor of holding the Philippines and Porto Rico. He might also have pointed to one decision in the income tax cases, rendered when the government was in distress and obliged to resort to this method of raising revenue; and another rendered during the last Cleveland administration, when the same necessity did not exist. The two decisions taken together justify Thomas Jefferson's observation that the constitution is revised every 30 years by interpretation. We have in our own State many instances of the reluctance of courts to denounce as unconstitutional statutes approved by public sentiment. Thus, though the constitution of the State provides that "all laws of a general nature shall have a uniform operation," our Supreme Court has upheld a statute making the employer liable for the negligence of a co-employee when the latter is employed on a railroad and not otherwise. This law applies to all railroads, whether owned by corporations or individuals, and therefore might seem to meet the requirements of uniformity as the same cannot be met by a franchise tax, from which the individual owner of a public utility is necessarily exempt because he has no stocks or bonds to list. Furthermore, the constitution of Iowa provides that "the property of all corporations for pecuniary profit shall be subject to taxation the same as that of individuals." This would seem to guarantee the gas company against a franchise tax not levied also against the individual owner of the competing electric light plant. The Supreme Court of Iowa seemed to encourage this view when it upheld a statute relating to the taxation of telegraph and express properties on the ground that the tax liability was the same whether the property was owned by a corporation or an individual. But our hopes were dashed to earth when it decided in the case of the Davenport National Bank that:

"Taxation of shares in an incorporated company, which may have some value in addition to the interest in the capital stock by reason of the goodwill, etc., of the business of the corporation, does not result in such inequality of taxation between the shareholders in the corporation and individuals holding property similarly employed as to make taxation unequal."

There is one chance left. In the case of the Davenport bank's competitor, such of his property as the assessor can find is liable to taxation for whatever it is worth. Therefore, some color may be found for the claim that the law guarantees him no exemption from a liability the Davenport National Bank must bear. But the statutes of Iowa expressly guarantee certain exemptions for which the constitution of the State does not provide. They exempt the stock of manufacturing and mercantile corporations and certain materials in the hands of the manufacturer and farmer. Whether the State may exempt any corporation for pecuniary profit from taxation on any part of its property, or whether it may deny to one class of corporations for pecuniary profit the exemptions accorded other corporations for pecuniary profit, are questions yet to be decided.

Meanwhile the demand for the enforcement of a franchise tax against public service corporations continues in every quarter of the union. This demand is made in the name of equality. It is said that the public service corporation should bear its equal share of the burdens of government. We answer that demand by declaring that equality is precisely what we want. And as proof of our good faith we announce our willingness to be measured by any rule or judged by any test which the State may be prepared to apply to all property, whether real or personal, and whether owned by corporations, individuals or firms.

This answer extorts from the advocates of the franchise tax the confession that the thing they demand—equality—is precisely the thing they do not want, and that, while shouting "equality" in public places, the thing they desire is the subjection of the public service corporation to a special burden. Then they proceed to give reasons why the public service corporation is not entitled to a "square deal" if the same consists in measuring its property for puposes of assessment and taxation by the yardstick applied to others. They say it should be deemed the exemptions accorded to individuals and to manufacturing and mercantile corporations because it holds special privileges and reaps monopoly profits which are excessive and illegitimate.

To begin with, these reasons are not based on fact, so far as Iowa is concerned. Under the law of our State no charter, exclusive in its terms, can be granted to any of the public service corporations, although circumstances may make the charters of some of them practically exclusive during the periods for which they run. The franchise tax applies to the gas or electric company that has to meet sharp competition in its own town. Again it does not apply to the individual who has no competition in the business of serving the community with gas, electricity, water, or all of these commodities. It is, therefore, not a tax on monopoly nor upon excessive profit, as it may operate when neither is present and may not operate when both are present. It is not a tax on a particular business, nor a tax on the franchise, since the same may be held by an individual. It is a tax on the privilege of resorting to the corporate form of organization for the purpose of conducting a particular business. While it is said to be aimed at the rich, and designed to give the young man a chance, it is a tax which applies to the young man of limited means who cannot use his franchise without organizing a stock company and does not apply to the man rich enough to finance the enterprise without the aid of others. So far as it concerns the smaller towns, it might properly be called "An Act to Perpetuate the Rich in Control of Public Utilities and to Keep Young Men of Limited Means out of the Business."

Not only is it untrue that a franchise necessarily involves special privilege in the sense of monopoly, but it is furthermore true that public utilities in Iowa as a whole, instead of yielding monopoly profits, have not paid the current rate of interest on actual investment since their foundation. Again, if the special privilege, assuming its existence, has been granted for the public good and convenience (and it never should be granted for any other reason), the public is not prejudiced by it and, therefore, should not desire to impose special burdens on its holders.

In cities organized under the general incorporation act in Iowa, no franchise can be granted except by vote of the people themselves, and in special charter cities in our State, the franchise must be submitted to the people upon petition of 25 freeholders in each ward; the statute furthermore provides that the city council may not contract away its right to regulate rates. Therefore complaint by the people of any Iowa municipality respecting special privileges or monopoly profits would be complaint of their own acts or the acts of their own servants.

The remedy for monopoly profit should be found, where such profit exists, not in taxing it, but in abolishing it through the power of the people to control the terms of the franchise, or the power of the city council to control rates.

The demand for a share of the monopolistic profit is unwise because it tends to reconcile the property-owning class to the levying of unjust tolls upon the tenants. Under this rule the greater the extortion practiced upon the tenant the greater should be the landlord's "compensation" in the form of large tribute to the public treasury by the extortionate public service corporation.

The true rule is fair rates and equal taxation, and this means taxation of the public service corporation according to the rule applied to property generally, whatever this rule may be.

Owners of patents, trademarks, etc., are holders of special privileges upon some of which they reap monopoly profits. But it is not proposed to apply the franchise tax to them. The explanation offered is that they have created the value which the government has secured to them by issuing trade marks and patents, while the community creates the value of the franchise held by the public service corporation. This theory makes no allowance for skill in management, though frequently a public service corporation which has failed under one management has succeeded under another, the terms of the franchise having meanwhile undergone no change.

Concession to this prejudice against crediting the public service corporation with the fruits of its own capable management should be made, when concession becomes necessary, in the form of a municipal tax on gross earnings. One advantage of the gross earnings tax is that it applies equally to corporations and individuals. Another is that it would go wholly to the community in which the public utility is located. The State, county, township, school and municipal government would receive each its share of the *ad valorem* tax, levied on the physical property used in the corporation's business, but the gross earnings tax would go wholly to the municipality, as the State could claim no share on account of the extortion alleged to have been practiced by the corporation upon the people of the municipality alone, and not upon the people of the State at large. I contend, not that the munici-

pality is entitled to a gross earnings tax, but that such an arrangement would be far better for the corporation than the franchise tax and should be the alternative offered by it when the necessity of choosing an alternative arises. As the constant dripping of the water finally makes an impression upon the stone, so has the public mind been affected by the constant assertion of public ownership and franchise tax advocates that the public service corporation is under special obligation to the community for a special privilege, and therefore should bear a special tax. The answer we should repeat with equal persistence is that one of the most valuable agencies in the improvement of cities is the enterprising and well-managed public service corporation, which extends its facilities through all portions of the community in which hope of profit lies and is content if it gathers to itself as the reward of its pioneering but a meager fraction of the value its improvements have added to outlying property whose owners have taken no risk. There be, as the Supreme Court of Ohio has said, reasons why an excise tax should be levied upon the liquor traffic, but is the service rendered by the franchise-holding corporations generally of such a nature that it should be coupled with the liquor traffic and subjected to the same respective penalties? This question is submitted to the advocates of the franchise tax in the hope that the opinions they have accepted through what Johnson calls "thoughtless tranquility" will be reviewed calmly and candidly and with the sincere purpose of according all a "square deal" in this important matter of taxation.

An officer of the Association has kindly furnished the following information concerning the laws of the several States relating to the taxation of gas companies:

State Tax on Gross Receipts.

Alabama—None.
Arizona—None.
Arkansas—None.
California—Law passed in 1897 which makes payment of 3 per cent. of gross receipts necessary after first five years of life. Franchises granted before 1907 are not subject to tax.
Colorado—None.
Connecticut—None.
Delaware—Wilmington pays ½ of 1 per cent. direct to State.
District of Columbia, Washington—Four per cent. of gross receipts in lieu of all other taxes.
Florida—Physical property assessed by State and county.
Georgia—None.
Idaho—None.
Illinois—In Illinois corporations pay a tax on capital stock but no percentage of gross receipts.
Indiana—None.
Iowa—None.
Kansas—None.
Kentucky—None.
Louisiana—Pay a license.
Maine—None.
Maryland—None.
Massachusetts—Pay proportion of expenses of State board and inspectors, and also tax on capital stock.
Michigan—None.
Minnesota—None.
Missouri—None.
Montana—None.
Nebraska—None.
New Hampshire—None.
New Jersey—Two per cent. of gross receipts under general franchise tax law.
New York—One-half of 1 per cent. of gross earnings paid to State.
South Carolina—None.
North Carolina—None.
Ohio—One per cent. of gross receipts.
Oklahoma—None.
Oregon—None.
Pennsylvania—Eight-tenths of 1 per cent. of gross earnings paid to date.
Rhode Island—None.
South Dakota—None.
Tennessee—None.
Texas—Corporation tax based on capitalization, $25 per $100,000.
Utah—Corporation tax only (small amount).
Vermont—None.
Virginia—None.
Washington—Annual license of $10 per year.
West Virginia—None.
Wisconsin—None.
Wyoming—None.

High Pressure Gas Distribution of To-day.

[A paper read by MR. H. L. RICE, Aurora, Ills., at the Thirty-third Annual Meeting, American Gas Light Association, Milwaukee, Wis., Oct. 18-20, 1905.]

Some 30 years ago, in the Beckton works, London, it was found that the two 48-inch lines into and through the city would not carry sufficient gas at full holder pressure, and pumping was resorted to. The pressure carried has increased slowly with the demand on the lines until to-day it is reported as about 2 pounds. The gas so pumped passes partly into holders and partly into the low pressure mains direct through governors. It is believed that this is the first authentic instance of the use in distributing ordinary illuminating gas of pressures higher than the few inches water pressure of common practice. A gradual increase in pressures carried on main distributing lines followed a few years later in several American cities, under conditions of duress similar to those in London, without, however, developing any decided sentiment in favor of the innovation. A 24-inch line, 18,000 feet long, in New York city, and still in use, although never followed in that city by any similar pressure installation, dates from 1880 and delivers directly into the low pressure mains. The pressure at the far end of this line is transmitted electrically to the pumping station, and 26 to 30 inches, or about 1 pound, is carried on the line when required. Brookline, Mass., Pawtucket, R. I., Derby, Conn. (for a short period around 1885), Philadelphia, Pa., Brooklyn, N. Y., Kansas City, Mo., and Terre Haute, Ind., during the gas war, all found more pressure a necessity and pumped to obtain it. A fan blower was installed here in Milwaukee at the Third Ward Works, in 1895, as a safeguard, and found emergency service the first year through the breakage of the main river pipe to the West Side. This and later emergency pumping in Milwaukee, first regarded as a necessary evil and then as a good servant, has developed into the fine pressure reinforcing system in use here to-day.

Probably the first high pressure line designed as such, where pressure was planned for and not the result of stress of circumstances, was laid in 1885, from Oakland, Cal., across the narrow arm of the bay to Alameda. This line was 4 inches, reduced to 2½ inches where submerged, and the gas was pumped with a rotary pump from Oakland under 10 pounds pressure into the holder at Alameda, a distance of 8,300 feet. Eight years later an 8-inch cast iron main was substituted, running 8 miles by a different route to the same holder terminus. Five pounds, supplied by a Roots exhauster, was used on this line, which in addition to supplying the holder, reinforced 2 low pressure districts through which it passed. In 1890 gas was pumped under 10 pounds pressure in Chicago, by a compressor, through an 8-inch wrought iron line about 4½ miles long, from the Mutual gas works to an outlying holder.

From 1890 also dates the high pressure distribution installation at Danbury, Conn., well known through the prominence accorded it in Mr. Shelton's early articles and discussions on high pressure, and the first example of the use of a district regulator and of compression storage tanks in distributing artificial gas. Other installations prior to 1899, working as quietly as successfully, were the forcing lines from Long Branch to Red Bank, N. J.; Elizabeth, N. J., to Rahway; Gloversville to Johnstown, N. Y.; and Louisville, Ky., between holders.

In 1899, at the meeting of the Western Gas Association, Mr. Shelton read his first paper advocating the use of higher pressure in gas distribution. By his keen analysis of the situation, his citation of work already accomplished, of natural gas practice and other high pressure work, he brought the subject for the first time prominently before the gas profession. This paper was followed by 4 others the following year, in which the line just built from Phœnixville to Royersford, Pa., was described. This line, feeding first a district holder and later a district regulator with the holder cut out, and also supplying customers along the line through individual regulators of natural gas pattern, another innovation in artificial gas supply, was from the start, and has since remained, a distinct success.

Under the spur of Mr. Shelton's energetic advocacy a few other installations followed in Pennsylvania, while the establishment of two successful lines near Chicago gave an impetus which was followed by

several systems in Illinois. General acceptance of high pressure was, nevertheless, slow and as late as January, 1902, the "Progressive Age" said editorially:

"As to high pressure distribution little progress has been made. There is no trouble to thus transport gas, but the question is yet open as to how much of the illuminating oils will be squeezed out and how much scrubbed out in transmission."

Rapid progress was, however, made in 1902, and recognition of the value of high pressure work became general the following year. The paper above quoted said, at the close of 1902, that the Waukegan experiment was satisfactory, and in the President's address before the Ohio Association, in the spring of 1903, is found the first official recognition in any Association President's address of the drift towards high pressure. Mr. Butterworth said, in his "Progress Department" that year that it is "now demonstrated to be a mechanical and economical success," and stated that 30 systems were then in operation.

Such hesitancy as there was on the part of our engineers to accept high pressure was largely due: First, to a fear of its effect on candle power; second, to the lack of proper formulæ for high pressure transmission. The mechanical difficulties it was seen could be overcome and the successful transmission and distribution of natural gas were acknowledged; but the question, "Would it pay in the illuminating field?" remained, until routed by broader knowledge and demonstrated success.

Briefly reviewing thus the history of the inception of high pressure transmission and distribution in our gas industry, it remains only to point out that, despite the early hesitating successes here and there in increasing pressure, despite the two earlier successful lines, one in the extreme East and one in the far West, successful but unknown, high pressure work as we know it to-day in America dates from the Phœnixville line of 1899. This also was the first line to dispense with any storage except the line itself and to demonstrate that it was simple, economical and practicable to lay a comparatively small pipe, put sufficient force behind it, and serve customers at the far end and along the way with perfect satisfaction. In reply to an inquiry as to the later history of this install ation, Mr. Shelton writes:

"We have never been bothered or heard from it in any way since. There was an old lady on a train once who asked the conductor if it stopped at a certain point. He said, 'No, madam; it does not even hesitate.' There has not been even the slightest hesitation on the part of the Phœnixville line, or any of the high pressure plants, as to their operation or delivering satisfactory results. I think it desirable to bring out the point of this continuous good work even on the first plant."

High pressnre work to-day stands solely on its own merits, an established factor in gas engineering. Its main recognized uses are: First, the transmission of relatively large volumes of gas to holders or district governors serving outlying communities; second, the direct distribution of gas through relatively small pipes; and third, the reinforcement of low pressure systems at selected points. In each case it is the marked lessening of investment outlay that commends high pressure and often the concentration of interest which it promotes. In transmission work low pressure is clearly outdistanced, in distribution large areas are profitably served where low pressure costs would be prohibitive, while in reinforcing work such large outlays have been saved by the recognition of the new principle that it may safely be said that every large gas undertaking in this country is to-day keenly interested in the possibilities of this phase of high pressure distribution.

To show the present extent of high pressure work there is appended to this paper (Appendix I.) a list with brief description of the present high pressure installations in the United States, as far as the writer has been able in a limited space of time to ascertain them, and which, though doubtless incomplete, evidences the rapid growth of high pressure work and the uses found for it. A few installations abroad, where high pressure is just beginning to receive attention, are also included

At the last meeting of the Ohio Gas Light Association a notable paper on long distance transmission was read by a natural gas engineer, the first contribution to our engineering councils, as far as the writer is informed, from the natural gas industry. And it is well that those who have in common this problem of the economical transmission and distribution of gas under pressure should thus come together for its proper solution and the standardization of its engineering practice. Natural gas work is far older in this field, while the stricter limits of our practice have led to the solution by our engineers of many problems previously unstudied. Our debt to natural gas practice must be freely acknowledged, and we may still learn from its successes. In compression work our practice has yet stopped at the limit of about 50 pounds pressure. A few instances of higher pressure are recorded, notably in California. Thirty pounds is about the general average for cross country and town distribution work, with the work in the larger cities yet confined to reinforcing pressure of 5 pounds and less. Two-stage compression, economical as pressures rise above 60 pounds, has not been necessary as yet, and simple, straight-line, steam-driven compressors are most in favor, with a few of the more economical duplex type and a few gas engine and electric-driven installations reported. Fan blowers are successfully used for the lighter boosting pressures and positive blowers economically used in higher work up to 5 pounds. Machinery used is generally in duplicate and is so simple in action that the complete absence of failures or working troubles is not remarkable. Compression costs are variously reported at 2 cents and under. A single stage compressor, delivering at 30 pounds, requires theoretically about 1.35 house power per 1,000 feet of gas compressed per hour, to which must be added friction and clearance losses. The actual horse power required in compressing 10,000 cubic feet of gas per hour with a straight line steam-driven compressor, located at Aurora, Ills., and calculated from indicator cards, is given in Appendix IV., and is, for 30 pounds compression, 17-horse power, or 1.7-horse power per 1,000. Noting for the moment that little more power is required in compressing the second stage from 50 to 300 pounds gauge pressure than the first, from 0 to 50 pounds, results actually secured in natural gas practice of 4-horse power for 300 pounds compression are not incomprehensible. With well-designed compressing stations, compression costs in our present practice may easily be under 1 cent. per 1,000, as claimed in many instances.

The problem of moisture removal has been satisfactorily solved by the application of carefully designed separators. The baffle-plate tanks designed by Mr. Goodnow and installed, one at his Waukegan station and one 500 feet out on the line, have done the work expected of them, and all trouble from ice has ceased in the North Shore lines. As the test of last winter was severe, with ice reported from at least one neighboring line not so well protected, this cessation of trouble in the system noted is reasonably convincing. Condensation troubles reported from other points can doubtless be successfully met in this manner, and in pressure systems drips already little used are destined to become things of the past.

No satisfactory method of measuring the gas delivered by compressors has yet been reported. Counters have proven unreliable, as slippage and efficiency vary, and proportional high pressure meters can only be accurate if at all at constant pressure. Measuring the gas delivered to the compressor station is practicable, but except in plants devoted solely to high pressure distribution, involves a considerable increase in investment. The use of a small, direct, high pressure meter at hours of minimum consumption, as a daily check on pipe line condition and compressor efficiency, has been suggested and will shortly receive a trial. For the carriage of gas at pressures not exceeding 5 pounds cast iron pipe is successfully used and most favorably regarded. It has also in a few instances been used at higher pressures, and specially designed joints are on the market for this work.

Cast iron lines are also being designed to be connected with couplings of the Dresser type, a type of connection which is attracting attention in low pressure work also. Universal pipe is being used on a high pressure, reinforcing main at St. Paul, Minn., now under process of construction. For pressures of over 5 pounds, however, screw-joint pipe of wrought iron or mild steel is most generally employed. In sizes of 8 inches and over certain natural gas engineers are on record as preferring couplings of the Dresser type throughout in place of screw-joints, on the ground of greater efficiency and more economy in laying. In the long, screw-joint lines, expansion sleeves are provided about every 500 feet, and valves are inserted at intervals of perhaps ½ mile for the isolation and repair of breaks. The history of the cross country lines has, however, been one of almost entire freedom from breaks or serious leaks. Electrolysis has been reported from a few installations and is generally thought more to be feared in wrought iron and steel lines than in cast iron. This trouble in the North Shore line has been successfully overcome by insulating the pipe with 10-foot sections of enamel pipe inserted at intervals, while on a new line, which has just been laid by the North Shore Company in a district of somewhat weaker currents, Dresser insulating couplings have been laid every 200 feet, as an experiment. Electrolysis trouble is reported this year on the North Adams line, a survey of which is at present in progrses.

The cost of laying cross country lines has been brought very low by careful division of the work, and in spite of the adverse circumstance of location often far from a base of supply. Ditching is started by a plow making a deep furrow and filling is done with a scraper. Pipe s

laid in sectious afterwards coupled by the expansion sleeves, and several gangs are employed in rapid work. On one 8 inch line laid last fall 3 pipe gangs of 12 men each, in a working day of only 7 hours, averaged 4,500 feet of pipe screwed together. This did not include testing or coating. The testing of these lines is done preferably with a small compressor operated by a gasoline engine or some convenient farm traction engine. Electric motors have been employed where interurban street car lines were within reach. Air pressures of 70 to 80 pounds are satisfactory for testing, and soap suds is universally employed. Where leaks are found which cannot be repaired by tightening, the coupling clamps of the Dresser type are employed. In a recent long run of 6-inch and 8-inch pipe these clamps averaged one to every 15 joints. They are simple and effective and believed to be lasting.

High pressure lines and distributing systems, properly laid, should be free from leakage, and properly protected from earth corrosion, should, in the absence of accidental causes, remain so. The importance of this subject of proper protection has been fully realized and the best low pressure practice has been brought to its solution. No particular coating has as yet won general acceptance, and several new preparations and methods are suggested, the value of which time alone can determine. No doubt the future will tell this story for high pressure more truly than the past, with the systems new, and inevitably with the detection of faults and the consequent further improvement of methods.

In view of the fact that fear of candle power loss was one of the principal factors in the slow acceptance of high pressure for manufactured gas, it is remarkable that full information should still be lacking on this phase of the subject. We know in general that the gas so far delivered under pressure has been uniformly satisfactory, and, roughly speaking, not appreciably depreciated in candle power or heat units; but for accurate figures we have thus far only 3 sets of tests. Those of Mr. Roberts, in 1899, showed no loss in candle power in gas pumped at pressures up to 50 inches, or a little less than 2 pounds. Those at Newton. Mass., in 1903, showed a gain in candle power at 5 pounds compression, but very considerable losses at 10, 20 and 30 pounds. The figures in these tests do not check well and the tests covered compression only, and not transmission. Finally we have the report of a Research Committee before the Ohio Association this year that "the loss in candle power in compressing coal gas up to the actual pressure of 25 pounds has been $\frac{3}{16}$ of a candle, and water gas, within 1½ candles; average, about $\frac{5}{16}$ of a candle loss." This report covered 6 months daily tests made at the compressor station with each kind of gas. Tests at pressures above 30 pounds are entirely lacking and no experiments covering the effect of compression on heat units are yet reported. It sholud be pointed out also that comparative tests both of candle power and heat units at the delivery point of high pressure gas lines are as necessary as those at the compressor station, if full and accurate knowledge is to be obtained. If it can be shown that, as the capacity of present pressure lines is reached or as new lines have to be laid out, net economy in all other factors points to increased initial pressure, the importance of full and careful investigation will be at once indicated.

This brings us to the question of the flow of gas in pipes, a subject which has received far more careful attention than that of candle power and heat units. The early discussions on this subject show considerable groping in the dark as to the probable form of the high pressure formula, with openly expressed doubts as to the efficiency of increased pressures. According to the low pressure formula with which we have long been familiar, delivery increases only with the square root of the pressure, and in view of the relatively high value of diameter, the economy of such a method of increasing flow would be seriously open to question. The high pressure formula, as finally developed and in present use is, however, of radically different structure as to indicated pressure effect, a point which the writer desires to bring out clearly for consideration. This formula, not to consider refinements beyond the limits of our practical gas practice, is $Q = C\sqrt{\frac{D^5 (P_1^2 - P^2_2)}{L \quad g}}$ where L is length in miles and P is absolute pressure. The Pittsburgh formula, $g = 6/10$, has $C = 47.5$. Robinson's formula has $C = 48.4$, a difference less than practical variations in pipe diameters. Coxe's formula, from which the high pressure computer is compiled, has $C = 41.3$, while Oliphant employs a varying factor, which for 1-inch pipe is 42 and for 10-inch is about 49.9. Taking $g = 1$, we have C in the Pittsburgh formula changed to 36.8, which, according to Mr. Rix, in his recent valuable paper before the Pacific Coast Association, corresponds exactly with a well-known, air-delivery formula, as corrected by practical results. Results secured at Newton, Mass., with a 6-inch line 9,600 feet long, 10 pounds initial pressure, check closely with the Pittsburgh formula, while Mr. Oliphant checked his formula in delivering natural gas 100 miles into a gasholder through an 8-inch pipe, his factor for which is 47. A series of tests not hitherto made public were made at Aurora, in April of this year, through 22¾ miles of pipe line, results of which will be found in Appendix II. Not satisfied with the accuracy of these figures, and doubtful as to the effect of the numerous bends in the pipe, a series of tests on a smaller scale, in which close accuracy could be secured, was recently undertaken, details of which are given in Appendix III. From these tests the writer concludes that, as far as our information goes at present, we are safe in using the Pittsburgh formula for pressures of 3 pounds and over. Deliveries will probably somewhat exceed the calculated amount on straight runs of pipe as the pressures rise, while with crooked lines the excess will about balance the increasing resistance of the bends.

In examining the character of this formula it is at once seen that, as the initial pressure becomes relatively large compared with the final pressure, the amount delivered increases more and more in exact ratio with the pressure. Through 1 mile of 4-inch pipe discharging at atmospheric pressure the theoretical amount which will be delivered per hour is as follows:

Gauge Pressure.

At 5 pounds.....	20,064	cubic feet.
" 10 "	30,400	"
" 15 "	39,520	"
" 20 "	48,032	"
" 25 "	56,392	"
" 30 "	64,448	"
" 50 "	96,216	"
" 100 "	173,280	"
" 200 "	326,040	"
" 300 "	478,344	"

If for convenience we speak of amounts delivered in exact ratio to the pressure applied as 100 per cent. efficiency, it is seen that although in an increase from 5 to 10 pounds initial pressure we obtain only 76 per cent. efficiency, in increasing from 25 to 50 pounds we obtain 85 per cent., between 50 and 100 pounds 90 per cent., and in an increase from 200 to 300 pounds 98 per cent. efficiency. An earlier understanding as to the effect of pressure on delivery would have materially hastened the general acceptance of high pressure work, and the facts should be kept clearly in mind in considering its further possibilities.

As high pressure lines or distributing systems not connected with storage holders approach their capacity at peak load with an initial pressure it is not desired to exceed, the question of proper storage will become important.. The majority of the lines already built have not yet had to face this question, for with large excess of capacity the peak load has been cared for by expansion in the line and additional pressure. Every high pressure line is a storage reservoir, with its peak load efficiency as such gradually decreasing with the distance from the point of delivery. Compression storage placed at the beginning of the line adds capacity storage to the line at the most disadvantageous point, and it is not clear why several plants, notably in California, have adopted this principle, and why in addition pressures are maintained in these tanks higher than required and used in the lines. These tanks so placed add nothing to the peak capacity of the line and provide no greater margin of safety of pressure supply than lies in sufficient duplication of machinery at the compressing stations. On the contrary, it seems clear that they should be placed at the delivery point, and so placed and made a part of the line at the line pressure, compression storage is efficient and reliable. It is conceivable, however, and an interesting possibility, that in a works of moderate size, devoted solely or in large measure to high pressure work, it might be found advantageous to use compression tanks at relatively high pressure for the sole storage, or a needed increase in storage, of the works; but this would appeal solely as a works' problem, and as related to the investment and maintenance cost of low pressure works' storage and the relative cost of compression, and not affecting in any peculiar way the transmission of the gas to distant points. No such works' storage as such is, however, known to the writer, and it is not probable that compression storage for works of any magnitude can ever compete with the present method. Compression storage at delivery points is in successful use on the North Shore of Chicago, where it gives perfect satisfaction. The tanks for this work hold 3,000 cubic feet of free gas at 30 pounds pressure, and cost in place approximately $400 each. This is a moderate cost per 1,000 stored for small storage, and should line pressures rise in the future, cost of outlying storage of this nature could be brought quite low with the increased capacity afforded. Outlying com-

pressors second-staging into outlying tanks, to increase their capacity, might be a possibility in particular installations, but could not generally be considered economically advantageous.

The 3 methods of distribution from high pressure lines have already been indicated. Where low pressure holders are used the high pressure problem is simply one of the transmission to the holder, and is in no way related to the low pressure distribution. Holders will continue to be used where low pressure distribution is preferred, and where district storage is desired for peak load and safety of local supply. They allow the greatest efficiency in pumping and afford a maximum capacity to pumping lines, but their cost of maintenance is considerable and they have the disadvantage of restoring moisture and consequent frost trouble to a dry gas. In moderate sized undertakings it seems evident, and especially so if pressures come to be carried higher, that the relative merits of low pressure and high pressure outlying storage will become a serious subject for investigation.

The second method of distributing high pressure gas is that by which a district governor is interposed between the pressure line and the low presure system, and the principle is unchanged whether the entire supply is thus furnished or an existing supply reinforced. The advantages of belt line reinforcing under pressure are so obvious that they require no comment, and the subject is fully covered in the description of the St. Louis system, made a part of this paper. For the sole supply to outlying territory where local low pressure distribution is preferred, the high pressure line and district governor is the cheapest installation that can be made. These district regulators, now made in almost any size of low pressure delivery desired, are simple, certain of action and give practically no trouble. They are preferably set in duplicate, with one side always in reserve, and have a large safety blow-off for emergencies. Their range of action is wide, and those which have come under the writer's observation have operated between extreme limits of 1 and 50 pounds without any alteration of pressure on the low pressure side. In an installation of this character it is seen that the compressors must be run according to the demand and that no reserve supply exists beyond the capacity of the line at the pressure of the moment, the efficiency of which has already been discussed. In most present lines the capacity of the line itself is still relatively large, the pressure range is low, compressors are not overtaxed at maximum demand, and peak loads are as yet easily met. Outlying compression storage, however, adds to any such installation flexibility and capacity, and adds them in small units at moderate cost as required.

The most marked increase in high pressure work has been in the so-called direct systems, where all the distributing mains are under the line pressure and can, therefore, be run with small pipe at a greatly reduced investment cost. Roughly speaking, and for the same percentage drop, a 1-inch high pressure main compares with a 3-inch low pressure, and a 2-inch high pressure with a 6-inch low pressure, with the reserve margin of supply, however, in favor of high pressure. This system has been taken up with distinct success for towns and cities of moderate size and for the outlying suburbs of larger cities. As yet it is not favored in thickly settled communities and business centers, where the cost of street main investment is of relatively less moment and danger from sudden leakage of much greater concern. In many of our modern cities consumption per foot of main is greater over large areas than it would be economy to attempt to supply under pressure, while on the other hand direct high pressure has opened up gas consuming territory where the consumption per foot of main would be absolutely prohibitive to low pressure. In the middle ground no clear line is fixed to-day, but high pressure is gradually invading the low pressure field, and it may be noted that those engineers who started with district governor systems are now installing high pressure direct in similar undertakings. These systems generally consist of from 2-inch to 1-inch mains, and the investment cost averages about ⅓ that of low pressure distributing mains. The average service tap is ¼ inch, and saddles with lead gaskets are used. Three-quarter inch services are the rule, and a great advantage in high pressure work is the length of service which can be run. Several makes of individual regulators are on the market which give a close regulation and cause practically no trouble. Three distinct improvements, simplifying high pressure distribution work, may be briefly noted: The simplest tapping machine ever invented—it may be carried in one's pocket—a saddle which dispenses with the corporation cock, saving money and adding strength; and a mercury seal at small cost, easily set up and certain in action. These three appliances are shown here before you. In high pressure work dead ends are not apparently harmful, and the company with which the writer is connected is now running all its side streets with 1-inch main controlled by 1 corporation cock, the services being taken off from tees. The smaller high pressure mains are generally laid on top over the center of the ditch, which can be cut very narrow. This allows a perfect job of second coating, and the pipe can be strung, tested and recoated very rapidly. Mains and services need not be graded, as no condensation should be feared. The cost of high pressure services is about the same as that of low pressure services. The saddles cost from 30 to 50 cents, the regulators $2.85, the lock-cocks 40 cents and the safety seals 40 cents, or a total special cost for high pressure services of about $4, easily saved in the lesser cost of the pipe in services of any length. The gas supply on the low side is absolutely steady and gives perfect satisfaction, and a ¼-inch high pressure service affords a relatively large margin of quantity. Gas engines may be used from the same service as lights, provided only a separate regulator is set. The safety seals will easily take care of any defect in the regulators, while in case of blow-outs the maximum quantity of gas which can pass the small bore-lock cocks under 10 pounds pressure is about 500 cubic feet per hour.

In connection with this paper it was thought that a description of 2 high pressure systems, which by their magnitude have attracted attention, would be of interest. And there is, therefore, presented for your consideration the main details of the reinforcing system of the Laclede Gas Light Company and of the high pressure distributing system of the Western United Gas and Electric Company. Mr. W. A. Baehr, Engineer of the first named Company, has prepared a description of the St. Louis system, a courtesy acknowledged by the writer, who presents it in its entirety.

A Description of the Five-Pound, Medium Pressure Distribution System Installed in the City of St. Louis, Mo., by the Laclede Gas Light Company.—The Laclede Gas Light Company uses for its ordinary low pressure distribution system the same kind of system as is in general use in cities; viz., cast iron pipe of various sizes, and fed by district holders located at the most advantageous places obtainable. This low pressure system is destined to conform to our ideal system of distribution, which is figured on the basis of a square mile of the heaviest district consumption in the city. The total amount of gas we are able to store in holders amounts to 12,500,000 cubic feet.

These holders take care of a large portion of the ordinary low pressure distribution during day and night. However, it was found that during the heavy lighting and cooking hours, or during the peak load, that these holders were not able to give satisfactory pressure in the distant parts of their respective districts, except by raising the pressure at the holders extremely high. To remedy this in the way usually adopted in such cases would mean that more district holders would have to be erected or very large low pressure mains run. To avoid this and at the same time to secure a more satisfactory service by being able to install outlets wherever we desired, and also taking into consideration the future development of the city, it was determined to put in a medium pressure belt line of large diameter. For this purpose a 24 inch cast iron pipe was adopted, and the pressure fixed at 5 pounds per square inch. The reasons for adopting cast iron pipe and for fixing the pressure at 5 pounds per square inch were as follows:

Electrolysis is so severe in this city that the use of unprotected wrought or steel screw pipe was out of the question; therefore, cast iron pipe had to be adopted, and we felt that 5 pounds per square inch in cast iron pipe was reasonably high. Furthermore, the pressure of 5 pounds per square inch was limited by the pumping machinery. The efficiency of positive rotary blowers with gas drops rapidly above about 5 pounds per square inch pressure. Had we wished to adopt a higher pressure, or say 10 pounds per square inch, it would have been necessary to put 2 blowers in series, or to use blowing engines. With a still higher pressure of about 20 pounds per square inch or more, we would have been obliged to use compressors, which with the large amount of gas to be handled would have been a doubtful expedient.

This belt line will form a complete belt around the city when finished. The gas for this line is supplied from the storage holders and forced into the line by means of positive rotary blowers. These blowers are able to deliver gas against a pressure of 5 pounds per square inch. Some are driven by steam engines and others by gas engines. During the mornings and nights, or during the light loads, these lines act as pumping lines to fill the various district holders from the works, and during the hour of peak load the lines may be supplied from the 2 works and 2 holder stations.

The pumping plant at Station A consists of 4 positive rotary blowers, each having a capacity of 150,000 cubic feet per hour against a pressure of 5 pounds. Each unit is driven by means of a direct connected simple steam engine. Station B has one unit with a capacity of 500,000 cubic feet per hour against 5 pounds, driven by a compound steam engine by means of a belt, and one unit of 150,000 cubic feet per hour

against 5 pounds direct connected to a simple steam engine. Station H has one unit of a capacity of 500,000 cubic feet per hour against 5 pounds, driven by means of a direct connected horizontal gas engine. Station G has one unit with a capacity of 500,000 cubic feet per hour against 5 pounds, which is driven by two vertical gas engines through a chain of gears.

At points where the pressure in the low distribution system was low, we installed manholes, having a connection to the 5-pound medium pressure distribution system or belt line, and outlets into the low pressure distribution system through suitable governors.

Each one of these manholes contains, besides various valves, two diaphragm governors of the Johnson-Reynolds type, with extra heavy leather diaphragms. They are exceedingly sensitive and can pass about 200,000 cubic feet per hour each. Two governors are used in series for safety. Should one governor give out, or for some cause refuse to operate properly, the remaining governor would take up its full duty and reduce the pressure from 5 pounds per square inch to the desired pressure in the low distribution system, as both governors are designed to act singly or in series.

These manholes are built in the street. The walls are concrete and the roofs are of I-beam construction, with expanded metal and concrete arches. The whole structure is water-proofed by means of several heavy coats of asphaltum, which is applied on the outside of the walls of the manhole. They are lighted by electricity and have a drain which is connected to the regular city sewer system. The entrance to these manholes is by means of an opening in the roof. The cast iron manhole cover is counterbalanced, making it very easy to raise and close same, and has a self locking device. The manholes are ventilated by running a 3-inch wrought iron pipe from the upper part of the manhole to some convenient telegraph or lighting pole, the pipe extending up the pole for about 8 or 10 feet. We have had no trouble whatever with the 5-pound system.

The High Pressure Distributing System of the Western United Gas and Electric Company.—One of the first projected high pressure lines was the Fox river line of the Aurora (Ills.) Gas Light Company, running 12 miles north from Aurora, and supplying 4 towns. From the Fox river line, and the later and equally successful line of the La Grange (Ills.) Gas Company, has been developed the present extensive system of the Western United Gas and Electric Company, supplying 24 cities and towns west of Chicago, with a combined population of 140,000 and an extreme distance between centers of 52 miles. The later pipe lines of this system have been planned with a view of establishing one large manufacturing station for the entire system at Joliet, which point has great advantages of location. At present there are 4 main gas works all connected with the pipe line, while a fifth is a small works at Lockport, soon to be shut down. The coal gas plants at Joliet, Elgin and La Grange pump their gas into the pipe line, and the combination coal and water gas plant at Aurora puts in or takes out from the line, according to the pressure conditions. Here is seen the curious arrangement of 1 water gas plant reinforcing as needed 4 coal gas plants separated by many miles, allowing them all to be run at their maximum efficiency. Holder stations are maintained at Joliet, Aurora, Elgin and La Grange; district governors at Batavia, Geneva, St. Charles, Hinsdale and Downers' Grove, while all the other towns are direct high pressure. With compressors pumping at the 4 extremes of the line the pressure carried at present is moderate, averaging 15 pounds, with no marked drop at any point. The line has, however, been tested throughout at pressures of from 60 to 70 pounds.

Beginning at Joliet, the line runs 8-inch through Plainfield to the hamlet of Copenhagen, 16½ miles, where it branches 6-inch to Aurora, 7½ miles, and 6-inch to Downers' Grove, 12 miles. From Aurora the line runs 5-inch and 4-inch due north 23 miles to Elgin. From Downers' Grove it runs 4-inch east and north to the towns along the Burlington and Northwestern railroads.

Extensions to Dundee, north from Elgin, and West Chicago, west from Wheaton, are underway, and a line will shortly be run from Joliet to Lockport. There are 85 miles of high pressure main pipe line, 275 miles low pressure mains, and 50 miles of direct high pressure mains in the system, serving 19,200 consumers, of which number one-sixth depends solely on the pipe line. The gas consumption is now at the rate of 550,000,000 cubic feet, to which the towns dependent on the line contribute their full share, although many of them are still in process of development as gas consuming territory. The high per capita consumption of these suburban towns may be briefly indicated. Hinsdale (district governor station, population 3,100) contains about 600 houses, has 554 gas meters and consumes 15,750,000 cubic feet per year. Western Springs (direct high pressure, population 750) contains 140 houses, has 126 meters and consumes 3,430,000 cubic feet per year. As showing the possibilities of high pressure work in small towns, we may note Plainfield a farming town on the line (population 1,000) with 190 possible consumers. It was piped high pressure this year, with 1-inch and ¾-inch mains radiating from the central trunk line, at a total cost of only $1,290, and contains already 150 well-satisfied gas consumers.

The most interesting feature of this system is naturally the proposed concentration of manufacture, which will make all the consumers of the Company, except those in Joliet, dependent on the pipe line. Starting with 50 pounds pressure at Joliet and allowing only 10 pounds drop to the branch at the end of the 8-inch line, it is easily figured, allowing for the relative low pressure consumption of Joliet, that this would care for a daily output about 40 per cent. in excess of the present maximum. A drop of 10 pounds more would carry into Aurora the entire relative consumption of Aurora, Elgin and the Fox river towns, while, should the Elgin gas be carried by a different route in the future, the drop would be much less. Thus the margin of pressure is considerable, and no less so on the other branch, with, however, the necessity of repumping into Elgin by the present route, unless the initial pressure at Joliet is raised about 50 pounds. The several holder stations will be maintained, but further than this no plans for outlying storage have been considered. The existing water gas plants and compressors at the outlying stations will be maintained for auxiliary supply if required.

Such in brief are the main details of this extensive plan soon to be carried to completion, a legitimate result of high pressure development. The success of this plant, and of similar operations in New Jersey, will clearly point the way to the manufacturing economies of the future.

In concluding a subject far too comprehensive to be adequately covered in a single paper, the writer will again call attention to the immediate need of definite knowledge as to the effect of higher compression on the candle power and heating value of manufactured coal and water gas, and more especially as to the heat units, as each year sees direct candle power of less importance to our consumers. Working with 2 or more stages in compression instead of 1, common practice in other pressure work, 6 times the pressure can be secured with about twice the horse power. Six times the pressure means 5 times the delivery. With economical engines and compressors the steam cost of the additional horse power will be still further reduced in comparison with present installations. These are the everyday facts of the natural gas engineer, who pumps his product at greatest economy at about 300 pounds pressure. Standing as the advocate of nothing but the careful scientific investigation of the problem before us, the writer notes that the drift is already towards higher pressures than those we have been content with, and that concentration in our industry beckons the way.

Appendix I.

List of High Pressure Installations (Pressures of One Pound or More) and Reinforcing Systems Now Operated in the United States Transmission Only.

Camden, N. J.—Thirty-five miles of 12-inch wrought iron main to holder at Trenton. Supplies Riverton, Burlington and lesser places en route through district regulators. Compressors used.

Chicago, Ill.—High pressure supplied by compressors is used extensively in Chicago for transferring gas between holders. One line over 5 miles long delivers over 1,000,000 feet a day.

Fall River, Mass.—Transmission to outlying holders at 3 pounds pressure by blowers.

Hackensack, N. J.—Six miles of 5-inch forcing main to holder at Rutherford. Duplicate Ingersoll-Sergeant compressors. About 12,000 cubic feet delivered per hour, requiring about 5 pounds pressure.

Long Branch, N. J.—Seven miles of 16 and 12-inch cast iron main to Asbury Park, with 7-mile branch of 10-inch to Red Bank; two pounds pressure. Exhauster used. Equitable house regulators used along line. Several small branch mains are supplied with low pressure through regulators. This system in operation since 1896.

Louisville, Ky.—Ten-inch wrought iron line, 2¼ miles to outlying holder; 6 pounds. Compressor used.

Norfolk, Va.—High pressure pumping line from 6-inch low pressure main in southeast part of city to holder across river in Berkley; 3-inch wrought iron line pipe to and from river bank; 1¼-inch lead pipe across river; 3 pounds pressure; delivers 3,000 cubic feet per hour. Laidlaw-Dunn compressor, electric driven; 1 kw. per 1,000 cubic feet delivered.

Oakland, Cal.—Eight-inch cast iron line, 8 miles to outlying holder

in Alameda, five pounds; also reinforces 2 low pressure districts through Connelly governors. Roots exhauster.

Rockaway Beach, N. Y.—Five and one-half miles of 4-inch to holder at Far Rockaway and 7½ miles of 6-inch from Far Rockaway to holder at Lynbrook. The 4-inch is wrought iron screw pipe, with Dresser sleeves every 1,000 feet. The 6-inch is wrought iron pipe with Dresser joints throughout. Duplex Ingersoll Sergeant compressor, 15 to 40 pounds. Considerable condensation. Reinforcing at one point by valve connection.

Seneca Falls, N. Y.—High pressure pumping line from works to holders at Seneca Falls and Waterloo; 26 miles of line passing under Cayuga Lake; 6 pounds pressure.

HIGH PRESSURE TRANSMISSION LINES WITH LOW PRESSURE DISTRIBUTION DIRECT THROUGH DISTRICT GOVERNORS.

Altoona, Pa.—Six miles 3-inch wrought iron pipe to Hollidaysburg. Westinghouse compressor, 6 pounds; district regulators at Hollidaysburg; individual regulators along the line; ¾-inch services.

Aurora, Ills., Western United Gas and Electric Company.—This system comprises various methods of high pressure distribution and is fully described in the body of the paper.

Chester, Pa.—Nine miles of wrought iron line, Dresser joints, to Darby and Media. Line to Darby is 6-inch and branch to Media is 4-inch; district governors used. Also serves the territory of the Suburban Gas Company, of Philadelphia—some 3,000 customers—through about 40 miles of direct high pressure mains and services.

Chicopee, Mass.—Five miles of 3-inch line pipe to Williamsett, with 2½-inch branch, 3 miles long, to small suburb. District governor in Williamsett. The 2½-inch line is direct high pressure, but also reinforces low pressure system of Chicopee Falls; 10 pounds pressure carried. Westinghouse compressors.

Danbury, Conn.—Two-inch wrought iron line to Bethel, 4 miles; 40 pounds pressure; 2 compression tanks and district regulator at Bethel. Compressor used. The superintendent writes: "I can only say that we are still supplying Bethel in the same way and with the same apparatus. The service is satisfactory and the business is slowly growing."

De Kalb, Ill.—Six miles 4-inch line pipe to Sycamore; duplicate Rand drill compressors, 15 to 20 pounds; duplicate Johnson-Reynolds district regulators at Sycamore; Johnson Reynolds house regulators along the line.

East Saginaw, Mich.—Four-inch emergency high pressure line of extra heavy line pipe across river. Style 3, Dresser river sleeves at each coupling. Rand drill compressor; Johnson-Reynolds district regulator. This is auxiliary to 12-inch low pressure main.

Elizabeth, N. J.—About 15 miles of 8, 6 and 4-inch wrought iron main. Screw joints, with Dresser coupling, every 250 feet. Begins at Elizabethport, reinforces the ontskirts, the low pressure system of Roselle, Cranford and Westfield; supplies Rahway, Linden and Woodbridge and helps out Perth Amboy branches, and supplies 3 other points. Further entension contemplated. Johnson-Reynolds district and house governors used. Only moderate pressure, supplied by exhauster, is now carried, but the line is designed for high pressure as required.

New Orleans, La.—Eight-inch high pressure steel line under Mississippi River to Algiers. District governor at Algiers. This remarkable line was fully described in a paper by Mr. Thomas. D. Miller before the Western Gas Association, meeting of 1903. On the New Orleans side it is joined to the reinforcing system, separately listed.

North Adams, Mass.—Five miles of 3 inch wrought iron pipe to Williamstown and 5 miles 4-inch to Adams; 2 distinct lines; duplicate Johnson-Reynold district governors in each town; Johnson-Reynolds house regulators along the line. System very satisfactory, and low pressure system free from frost.

Phœnixville, Pa.—Five mile line to Royersford and Spring City; 3-inch line pipe, Equitable and Fulton district governors; 20 pounds compression.

Schenectady, N. Y.—4,300 feet 4-inch line to General Electric Company's plant; 10 to 35 pounds. The General Electric Company takes charge of this within its own plant.

Sunbury, Pa.—One mile 2-inch wrought iron main laid this year to Susquehanna silk mills. Laid to avoid taxing low pressure system, which it it will ultimately reinforce; Clayton duplex compressor, 15 pounds.

HIGH PRESSURE DIRECT.

Amesbury, Mass.—Direct system; 350 consumers.

Blue Island, Ill.—High pressure system throughout. Supplies Harvey, Morgan Park, Riverdale and Posen; 60 miles of mains, 6-inch to 1½-inch wrought iron line pipe, with Dresser couplings at intervals, and Dresser specials, 15 pounds pressure. The Northwestern Gas Light and Coke Company states that the system is so satisfactory that a ltne was run from the Cicero works last year into thinly settled territory, and 25 miles will be run this year to supply the villages west from Evanston.

Chicago Heights, Ind.—High pressure system throughout; 2 miles of 4-inch, 3 miles 2-inch and 10 miles 1¼-inch mains. Rand drill compressors 12 to 8 pounds, ¾-inch services, with a few larger power services; Johnson Reynolds house regulators, mercury seals.

Delray, Mich.—Direct system to adjoining towns; 5 miles 4-inch wrought iron pipe; Rand drill straight line compressors. System in operation only since February 10th, 1905,

Dover, N. J.—5 miles 3-inch wrought iron line pipe to Port Oram, with 3-inch to 1¼-inch mains in the town; McKiernan compressor, operated by Backus gas engine, 5 pounds pressure; Equitable house regulators; expansion sleeve every 1,000 feet. Some frost trouble reported where streets graded and pipe left only 1½ feet deep.

Easton, Pa.—2 miles 4-inch wrought iron line pipe to a district of 7,000 population; 10 to 20 pounds pressure; duplicate tandem district governor in center of district reduces to 3 inches; condensation collecting chamber 1,000 feet from compressor. No trouble and very satisfactory.

Grass Valley, Cal.—4½ miles 2-inch line pipe to Nevada City; mains in Nevada City 1¼-inch to ¾ inch; services ½-inch; gas compressed to 100 pounds into storage tanks at works; enters line through regulator set at 15 pounds; enters main system at Nevada City through a second regulator set at 4 pounds. The individual regulators reduce to 4 ounces.

Hammond, Ind., South Shore Gas and Electric Co.—Forty-six miles of direct high pressure mains, 2-inch to 1¼-inch, covering Hammond, Whiting, Indiana Harbor and East Chicago. Rand drill, straight line compressor, 10 pounds; Johnson-Reynolds house regulators; National Machine Works' mercury seal; taps in mains are ½-inch; lock cocks have ¼ inch opening.

Hancock, Mich.—Direct system throughout Hancock and supplies Houghton, across lake 47 feet deep; 12 miles mains, 4-inch to 2-inch; expect to lay 30 miles this year to reach and pipe Laurium; Westinghouse compressors, delivering into compression tanks at 40 pounds. Regulator on outlet of tank reduces to 8 pounds, which gives 6½ pounds at the far end. Sotid rock country. High pressure adopted partly that mains could be laid shallow. No frost trouble. Services 1¼-inch to ¾-inch. Johnson-Reynolds house regulators.

Ishpeming and Negaunee, Mich.—New plant; direct system: no low pressure; about 12 miles of main, 4-inch to 1¼-inch, laid this year.

Linton, Ind.—New plant; direct system; no low pressure; 6 to 7 miles of main, 4-inch to 1¼-inch, laid this year.

Long Beach, Cal., and Vicinity.—Direct system throughout; 22 miles of 4-inch to 2-inch line pipe; same methods as at Pasadena; which see.

Los Angeles, Cal.—At the present time this high pressure system covers the southwestern and southeastern portions of the city of Los Angeles, with 12 miles of 6-inch and 10-inch wrought iron pipe, 6 Equitable district governors being used to reduce the pressure from 15 pounds to inches. Also 10 miles of 6-inch wrought iron high pressure pipe, supplying part of the eastern section of the city of Los Angeles and the city of Pasadena. Consumers at Pasadena are supplied through a district governor, while the eastern section of Los Angeles is fed direct from the high pressure mains through gas regulators of the Reynolds and No. 1 Equitable types. On this line there are also 3 miles of high pressure branch lines supplying some 200 consumers in the city of Alhambra; also, 9 miles of 6-inch and 8-inch high pressure lines running to the city of Hollywood. Consumers at Alhambra and Hollywood are supplied with individual consumers' regulators. The present hourly sendout capacity of the compressors is 370,000 cubic feet of gas.

Marlboro, Mass.—Supplies Hudson with direct system; 35 pounds pressure.

Norfolk, Va.—Eight miles of high pressure main, 3-inch to 1¼-inch wrought iron line pipe, supplying northern suburbs; direct system. Rand drill straight line compressor; stopped at 25 pounds, started at 5 pounds. Equitable and Johnson-Reynolds house regulators.

Oakland, Cal.—3-inch to 6-inch cast iron pipe to Berkley, 11 miles, 2½ pounds or less as required; connected direct into low pressure system at Berkley, which is tied into low pressure system at Oakland; individual regulators along the first 3 miles of the line,

Pasadena, South Pasadena and Alhambra, Cal.—Direct high pressure system throughout; 43 miles of 6-inch to 2-inch line pipe; gas compressed into storage tanks at 80 to 100 pounds pressure, and delivered through regulator to give 20-inch to 25-inch at farthest point. Individual house regulators; Lowe pattern.

Pittsfield, Mass.—Twenty-five thousand feet 4-inch wrought iron pipe to Dalton; high pressure throughout Dalton, 2-inch, 1¼-inch and ¾-inch mains; Westinghouse air brake pumps used as gas compressors and very satisfactory; Dresser insulating joints every 500 feet; valves every ½ mile; Hickenlooper coating.

Redwood, Cal.—Five miles 3-inch O. D. line laid this year to supply Palo Alto; direct system.

Redwood City, Cal.—Eight miles 2½ inch line pipe to San Mateo and 2 inch belt line around San Mateo, with 1-inch mains in the town; straight line compressor, 10 to 35 pounds; Equitable regulators; expansion joints every 1,000 feet.

St Louis, Mo.—Six-inch steel screw pipe, with 2-inch and 1¼-inch branches from outlying station located on medium pressure belt line to suburb of Webster Groves; 2 gas engine driven compressors; capacity 5,000 cubic feet per hour each, delivering at 30 pounds. A few Dresser insulating couplings used and the line further protected from electrolysis by pitch where deemed necessary; individual house regulators of the Johnson-Reynolds type used.

Santa Rosa, Cal.—16.8 miles 2-inch steel line pipe to Petaluma; 2-inch to ¾-inch steel mains in Petaluma; compressor used with pressure of 10 to 40 pounds, according to demand.

Sterling, Ills.—Direct system supplying the 1st ward of Sterling and the city of Rock Falls; 4-inch to 3-inch wrought iron mains, with Dresser insulating joints at intervals; no drips; electric driven Erie compressor, requiring 1.1 kw. per 1,000 cubic feet gas pumped at 30 pounds pressure; Johnson-Reynolds house regulators.

Waukegan, Ills., North Shore Gas Gas Company.—Supplies 7 towns (2 added this year) through 55 miles steel line pipe, 6-inch to 1¼ inch; straight line compressors, 30 pounds; specially designed drip tanks at works; 2 pairs outlying compression storage tanks in service, each tank holding 3,000 cubic feet at 30 pounds; all districts except two are direct high pressure; two are served through district governors; some 6-inch main is cast iron, with special joints made by the U. S. Cast Iron Pipe and Foundry Company.

Reinforcing Systems.

Atlanta, Ga.—Two miles cast iron, independent main, delivering direct into low pressure system; Sturtevant fan to give 15-inch; not at present in use, as main system has been enlarged.

Baltimore, Md.—Two independent reinforcing lines, one 3 miles long and connecting into low system at far end; the other, a pumping line between two stations, has direct valve connection into low pressure system; Sturtevant exhauster used when required. These two lines were put in use 1 year ago, and have resulted in reducing the maximum pressure of the low pressure system from 8 inches to 4 inches.

Cleveland, O.—Three miles 6-inch wrought iron main, with Dresser joints throughout, reinforcing one district from old station; Ingersoll-Sergeant duplex compressor, 10 pounds; supplies low pressure mains through district governor.

Detroit, Mich—Sixty-five thousand one-hundred and thirty-six feet 16-inch reinforcing main in use in Detroit; cast iron main; now using cement joints. Expect to carry 2 pounds or more this winter.

Evansville, Ind.—Just starting to run a 4-inch high pressure main around the outskirts of the city to take in new territory and reinforce the low pressure system.

Fresno, Cal.—Two-inch reinforcing line completely around city, and 2 high pressure branches to outlying districts; some trouble with condensation, which, however, is mostly removed within 1,000 feet of compressor; connection to low pressure system is through regulators; 15 pounds carried; perfect satisfaction. High pressure services are ½ inch.

Indianapolis, Ind.—Two and a half miles 10-inch reinforcing main (a former natural gas main) is just being put in service this year. Laidlaw-Dunn compressor, 10 pounds; this line will connect through single Johnson-Reynolds 6-inch regulator with 16-inch low pressure main in heart of city.

Kansas City, Mo.—Four miles 16-inch cast iron pumping main, delivering direct into low pressure system at points 2 miles from works and beyond; 18-inch pressure when required; Sturtevant fan blower; system in use since 1895.

Lansing, Mich.—Three-inch reinforcing line to suburbs; Westinghouse compressor, 15 pounds; district regulator in manhole, connecting into low pressure mains with safety blow-off.

Milwaukee, Wis.—About 13 miles of cast iron boosting main, 24-inch, 20-inch and 16-inch; lead joints, tested to 70 pounds, connecting through 12 governors, 6-inch, 10-inch and 12-inch, into low pressure system. Connelly governors set 2 in tandem in watertight manholes; 20-inch pressure at works supplied by Roots blower. Expect to lay more main, add more governors and increase pressure as required. Variations in pressure on low pressure system reduced to less than 1 inch.

Minneapolis, Minn.—Five to 6 pounds is carried by Roots exhauster at works on independent main, delivering direct into low pressure system 3 to 4 miles from works; not entirely satisfactory.

Newark, N. J.—Here the mains to outlying holders are connected direct through valves into low pressure distribution system. The pressure on these pumping lines is maintained by positive exhausters and Sturtevant fans.

New Orleans, La.—Some 8 miles of 6-inch, 4-inch and 3-inch high pressure mains radiating from works in New Orleans, connecting through governors at 5 different stations with low pressure system. These governors are 2 in tandem, with duplicate set. The first governor reduces from 25 pounds to 8 ounces; the second from 8 ounces to 2 inches.

Newton, Mass.—Nine thousand six hundred feet 6-inch iron pipe, with "Learned" joint, reinforcing low pressure system through district regulator. Water cooled condenser at compressor.

New York City, N. Y.—24-inch cast iron independent main in lower part of city; in use since 1880; connects direct into low pressure system. Pressure carried up to 1 pound as required. Governed from station by electric recording device.

Omaha, Neb.—Two miles 12-inch cast iron main from works to outlying Connelly governor; pressure of 30-inch carried in winter by ordinary exhauster; fan used for ligher pressures up to 18 inches.

Philadelphia, Pa.—Extensive system of pressure mains for transferring gas between the several works and the outlying holders, pressures of 30 inch to 60 inch, and used to some extent for reinforcing low pressure areas by valve connections, and one governor connection.

St. Louis, Mo.—See detail description of 5-pound boosting system in body of paper.

St. Paul, Minn.—Now laying 2 miles of 3-inch reinforcing main of universal pipe. Will install a compressor and storage tanks at the station, and discharge from the reinforcing main at selected points into the city mains.

Installations Abroad.

Granton, England.—Five pounds pressure on pumping line to holders

London, England, South Metropolitan Gas Company.—Two 48-inch cast iron pumping lines to outlying holders with direct connection through governors to low pressure system; 2 pounds pressure carried.

Nuneaton, England.—Five miles high pressure main, supplying outlying districts, consisting of 3-inch bell and spigot steel pipe with lead joints, and 2 inch and 1-inch wrought iron screw pipe. The compressors deliver into a 15,000 cubic foot high pressure holder at works at 40 pounds pressure. A regulator valve at outlet of this tank reduces the pressure to 9 pounds on the system; individual house regulators used, reducing to pressures of 3 inch to 20-inch.

Heidelberg, Germany.—High pressure line to Ziegelhausen, Neuenheim and Schlierbach; 6-inch to 3-inch mains; rotary blowers, giving pressures up to 55-inch; district regulators used, reducing to 1.5-inch.

Lubeck, Germany.—A 12-mile line of 3.2-inch steel bell and spigot pipe to holder at Travemünde; lead joints, tested to 15 pounds; electric driven compressor to raise pressure when required to perhaps 10 pounds. Only holder pressure required at Lubeck as yet.

St. Margrethen, Switzerland.—Six-inch to 5-inch high pressure cast iron main, lead joints, reaching 9 towns in 2 branches from works. Will later take in 14 towns, with aggregate population of 40,000. One small, low pressure holder for every 2 towns, automatically cut off from pumping main when full. Holder pressure of 12-inch, plus natural elevation, sufficient so far, but 2 exhausters in readiness for additional pressure up to 240-inch, with automatic pressure by-pass. This region is at the southern end of the Lake of Constance.

New Work Reported.

Logansport and Wabash Valley Gas Company.—Will pipe 16 miles, from Peru, Ind., to holder at Logansport, 8-inch; and 15 miles in opposite direction to Wabash, 6-inch. Will use compressors and high pressure. Plans not fully developed.

Plymouth (Pa.) Wyoming Valley Gas and Electric Company.—Now building 5 plants for high pressure work.

Oakland, Cal.—Now laying 20,000 feet of 10-inch reinforcing main

through the center of Oakland, tested to carry 100 pounds pressure; 20 pounds will be carried at the start. A second compressor will compress from 20 to 80 pounds for storage in compression tanks which will deliver at 20 pounds through regulator. See report recent meeting Pacific Coast Gas Association.

Sacramento, Cal.—High pressure work is now being planned in connection with the Sacramento system. There will be several novel features in connection with this work and that at Oakland.

Steelton (Pa.) Dauphin Consolidated Gas Company.—Now installing a high pressure system.

Appendix II.

Tests Made of Flow of Gas Through 22¾ Miles of 5 and 4-Inch Pipe Between Aurora, Ills., and Elgin, Ills., April, 1905.

This high pressure line runs due north, from Aurora to Elgin, through the towns of North Aurora, Batavia, Geneva, St. Charles and South Elgin. There are about 1,500 consumers on the line, mostly served by low pressure through district governors. There are about 2 miles of 5-inch pipe at the start and the line is figured at the equivalent of 2½ miles 4 inch. There are 16 bends, all long sweeps, and four 45 bends. Afternoon periods of minimum consumption were selected for the tests. The gas (coal gas with a small percentage of water gas, gravity assumed as $\frac{6}{10}$) was delivered into small holder at Elgin, not in use, and measured by the rise of the holder. The test is rough and finer corrections were ignored, but, balancing all factors, it is thought the observed figures are probably within 10 per cent. The St. Charles figures are the more accurate, as on this new portion of the line few consumers were located at this time all of whom were closed off, and there were no distributing main systems connected. Each test lasted one hour from the time a state of equilibrium was established in the line.

No. 1.—Sunday afternoon, April 9th. Pressure at Aurora, 15 lbs.; pressure at St. Charles (10 miles from Elgin), 7½ lbs.; amount delivered into Elgin holder; 8,400 cubic ft. Theoretical delivery, Aurora pressure and distance; Pittsburgh formula, 8,528; Oliphant, 8,112; Robinson, 8,684; theoretical delivery, St. Charles pressure and distance; Pittsburgh 8,070.

No. 2.—Sunday afternoon, April 16th. Pressure at Aurora, 35 lbs.; pressure 1,200 feet from Elgin holder, 4 bends intervening, 2 inches of mercury. Failed to get pressure at St. Charles. Amount delivered, 16,170 cubic ft. Theoretical, Aurora pressure and distance; Pittsburgh formula, 15,645; Oliphant, 14,882; Robinson, 15,932. Theoretical, nearby pressure and distance: Pittsburgh, 15,835.

No. 3.—Test failed; pressure was not maintained at Aurora.

No. 4.—Friday afternoon, April 28th. Pressure at Aurora, 20 lbs; pressure at St. Charles, 9½ lbs.; amount delivered, 9,300 cubic ft.; theoretical, Aurora pressure and distance: Pittsburgh formula, 10,374; Oliphant, 9,868; Robinson, 10,575. Theoretical, St. Charles pressure and distance: Pittsburgh, 9,320.

No. 5.—Saturday afternoon, April 29th. Pressure at Aurora, 50 lbs.; pressure at St. Charles, 30 lbs.; pressure 1,200 ft. from Elgin holder, 3.1 inches of mercury; amount delivered 22,860 cubic ft. Theoretical, Aurora pressure and distance: Pittsburgh formula, 20,743; Oliphant, 19,731; Robinson, 21,122. Theoretical, St. Charles pressure and distance: Pittsburgh, 20,360. Theoretical, nearby pressure and distance, 20,527.

Summary.

Gauge Pressure.	Actual Delivery.	1,200 Ft. Distance.	Theoretical from Pressures at St. Charles.	Aurora.
15	8,400		8,070	8,528
20	9,300		9,320	10,374
35	16,170	15,835		15,645
40	22,860	20,527	20,360	20,743

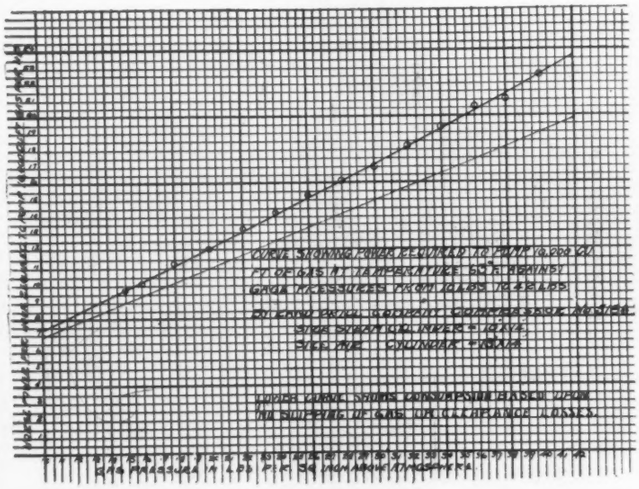
Appendix III.

Tests made of the flow of gas through 1,048 feet of 1-inch steel pipe, September, 1905. This pipe was laid around the gas works at Aurora from the inlet of the high pressure line to the station meter. The turns were such long sweeps that they may practically be ignored. The gas used was coal gas made in Joliet or Elgin, admitted from the pipe line at the pressures named, and passed through the station meter (previously verified) at unchanged temperature into the Aurora holder. The pressures up to and including 17 pounds were determined by a mercury gauge and above 17 pounds by verified spring gauge. They were maintained constant during each test,

Gauge Pressure. Pounds.	Actual Cu. Ft. per Hour.	Pittsburgg Formula, g—5.	Departure from Formula.	Per Cent.
1.20	550	618	—68	11.0
3.09	1,100	1,119	—19	1.7
4 51	1,350	1,402	—52	3.7
5.02	1,620	1,671	—51	3.0
10.64	2,390	2,381	9	0.4
13.51	2,950	2,787	163	5.8
17.00	3,550	3,258	292	9.0
25.00	4,580	4,295	285	6.6
30.00	5,325	4,933	392	7.9
35.00	6,000	5,520	480	8.7
40.00	6,977	6,141	836	13.6

Only when special conditions obtained could these tests be made, and it is regretted they could not be carried further. Plotting the results gives, however, practically a straight line after 6 pounds The plotted line shows a steady departure at the higher pressures from the curve of the formula, which approaches a straight line also, and suggests that a correcting factor could be discovered with more data of pressures and sizes to work from. The gravity of the coal gas was assumed at 5/10.

Appendix IV.



Acknowledgment is made to the many engineers and managers who have cheerfully furnished information for this paper: To Mr. George F. Goodnow, who will present a further paper on this subject next year, for his co-operation and advice; and to the writer's associates in Aurora (Mr. R. N. Strohn, Mr. P. O'Malley, Mr. Wm. Willett and Mr. Howard G. Stillson) for their assistance in the preparation of the data.

Tappers of Gas Mains.

By "G. D. R."

The inspector had reported suspicious circumstances at No. 1101 Q street. I was sent to investigate. I did not observe any unusual conditions about the place. I visited the candy making shop in the rear of the store and found several devices for preparing candy which were operated by gas heat. I examined the connections and found that the pipes were drawing the gas supply from the mains in the proper way, but as I was about to leave the place an Italian popcorn vender appeared upon the scene and I noticed a commotion among the two people back of the sales' counter. Evidently they were trying to signal the popcorn man to go away; but he failed to notice the signals. Even a tapping on the window plate front did not arouse his attention. I watched the proceedings. The popcorn man unwound a coil of hose and connected with a gas union at the base of the show window near the street. I had not noticed this before. In a few moments a fine gas jet was produced and the man commenced popping his supply of corn for the next tour. I investigated. I found that the pipe had no connection with the interior piping system of the building. This gas line was drawn from the street main. The connection was made with the street level pipe, as at *A*, Fig. I., and with the main, as at *B*, Fig. II.

I had the popcorn man arrested. It was found that he was innocent for the reason that he had been accustomed to pay a certain fee per

month for the use of the gas. He paid the confectionery manufacturer and supposed that the gas supply was properly accounted for through the meter of the establishment. We let him go free. He told us that other popcorn men had had the same privilege. It is always difficult to bring these offenders to trial, as is known to gas making men, therefore we made a settlement with the proprietor of the concern by which he paid for the gas we estimated he had stolen for a year. He fought hard, but he had the choice of settling up and agreeing to remove the false pipe connection, or having charges preferred. In another instance the proprietor of a second-class restaurant proved tricky. We had had many complaints from a business house next door concerning excessive gas bills. Almost every month a plea was made to the effect that we had overcharged on the account. Finally, an investigation was made. The pipe connections were examined thoroughly from the main to the meter and everything seemed to be in order. Just as we had given up the idea of finding anything wrong, we detected a small, black painted pipe, leading from a packed box containing the store pipe, as illustrated in Fig. 3. The pipe was fitted in such a way that it was in the shadow of the wall work. If we had not an electrical searching light we would not have seen it. This pipe was arranged to draw gas from the store pipe after the gas had passed through the meter; thus the draught of gas was on the store account. We followed the pipe and found that it passed through a side cellar wall direct to the aforementioned restaurant next door. We had no trouble in going into the cellar of the restaurant

Fig 1

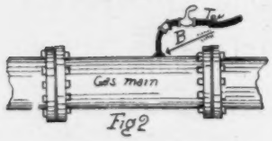


Fig 2

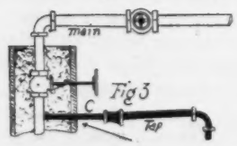


Fig 3

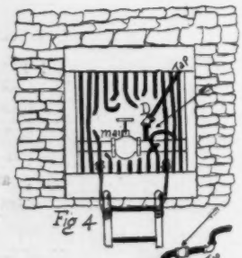


Fig 4

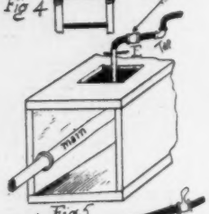


Fig 5

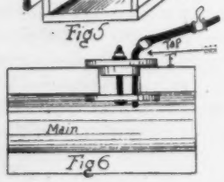


Fig 6

for the purpose of taking the meter; the proprietor did not even accompany us. It required but a few moments to trace the pipe line, which had been tapped to the next door neighbor's main, to the source of drain in the restaurant. This tap is marked *C*, in the cut. Of course the proprietor knew nothing about it; it was there when he took the place, he said. He had his gas pipes and his meter and he had no reason to draw gas from his friend's supply next door. Thus he argued! What could we do about it? We could have the man arrested. We could show that the false pipe supplied gas for some of his lights in the restaurant, but we could not prove that he made the connection. He swore he was innocent. He offered to pay whatever bill we drew up against him. He agreed at his own expense to remove the tap. He would willingly remunerate the proprietors of the store next door for the "error."

The last time I dragged a man to the police court for a similar offense the learned judge berated me in good shape for my apparent neglect to properly inspect the piping systems of my route and detecting "errors of connection." He asked me what I was paid for. I thought that he was going to make me apologize to the culprit, but he sent us both away and told me to be more attentive to my business in the future. The culprit gave me the merry "Ha! ha!" I went back to the office and got a detail of men to remove the tap while the guilty fellow looked on and laughed. I remembered this event, and accepted the proposition of the proprietor of the restaurant.

In another case I found gas robbers who were extremely bold. I was inspecting the alleys of a large pork packing establishment and found that some one had filed away the bars of a window, as in Fig. IV., and tapped the main, as at *D*. This line of pipe extended to the upper lodging room in the same building of some of the employees of the establishment. This was easy for me, as I had only to report it to the superintendent. I thought he would be "riled." He simply said, "I thought the gas bills were high last month." My next trip was a month after and the pipe was there just the same. The "super." said he forgot; he still "forgets." Fig. V. is another drawing of a tapping plan that came to notice. The main was carried in a wood shute. A section was cut from the wood on top and the tap line inserted, as represented at *E*. In this case the shute was underground, so that only the tap line extended above in view. This combination was close to a wall. The pipe passed through a hole cut into the wall, and reached into a metal working shop. The owner said he had been trying for months to get the gas company to put in a main for him. Finally he got mad, so he said, and tapped the first main he could locate. He said he intended to make out his own gas bill and send it with his check to the company at the end of each month; but he forgot to do this.

Fig. VI. shows the way one man tapped a main. It is a sectional view. The man made an almost complete "manhole" in the pipe and put his tapping line *F* through the head as shown. He labored hard for quite a while to do this. The tapping pipe ran from here to the point of use. We got this man good and hard, for injuring our pipes. We could not prove he had used gas, but we proved he had injured our pipes. He said our pipe leaked at that point and he was simply good enough to stop the leak for us to save us the bother, you know. He was fined, and also had to pay the cost for the putting in of a new pipe section.

Oxide of Iron as a Purifying Agent, and Its Valuation as a Raw Material and in a Spent Condition.

By H. Leicester Greville, F.I.C., F.C.S., in *Journal of Gas Lighting.*

Whatever concessions the gas companies have been able to obtain from our legislature over conditions of testing for illuminating power and exemption from excess of so-called "sulphur compounds other than sulpheretted hydrogen," there is one point on which it may be safely prophesied that no further concession will ever be made—viz., that the gas supplied to the public must be free from sulphuretted hydrogen; that is, practically free, not in an ideal sense of not containing an amount which could not be possibly detected by the most stringent scientific tests.

This condition is only reasonable, considering the facility with which sulphuretted hydrogen can be removed from crude gas by the use of various forms of oxide of iron. The old system of testing was far too stringent; but recent parliamentary regulations have afforded some relaxation. It has always been an anomaly that, whereas the total sulphur in the gas should be permitted to amount to between 17 to 22 grains per 100 cubic feet, the proportion of sulphuretted hydrogen should not have been allowed to reach as much as one-millionth part of a grain. The products of combustion of carbon disulphide and sulphuretted hydrogen are exactly the same with regard to the vitiation of the air by sulphur dioxide; and yet such a wide distinction was made over penalties in the one case and in the other.

Further, the introduction of water gas (a necessity of the exigencies of the gas industries) made it more difficult to purify the gas from sulphuretted hydrogen, to an extent which would pass the most exigent of scientific tests. The light hydrocarbons from the carburetted water gas plant seem to pass forward through the usual scrubbing and washing appliances, condense in the pores of the purifying material, and partially neutralize the completeness of the usual chemical reactions which might have been expected under normal conditions. All this rendered some relaxation of the system of testing more necessary.

The elimination of sulphuretted hydrogen by means of revivified gas liquor in closed vessels, is an ideal which will probably never be completely realized, although I have no doubt that the bulk of this form of impurity may be removed in this way. The main fact remains that, for keeping gas free from sulphuretted hydrogen, some form of oxide of iron is the best to employ; and of all forms of oxide of iron that known as "Bog Ore"—containing hydrated ferric oxide deposited on a peaty basis—is the most efficacious. I am quite aware that "Weldon Mud" and other materials have been advocated as substitutes; but from long experience, I am still of opinion that native bog ore is, from many considerations, the best material if it can be secured at a favorable price.

Natural deposits of bog ore exist in large quantities in many localities, British and Continental, but of varying qualities. A material rich in iron may be considered unsuitable on the ground of a high percentage of inert matter of siliceous or aluminous character, the use of which may be considered undesirable by a competent gas manager on the ground of throwing an undue amount of back pressure on the purifiers. This difficulty can, of course, be mitigated by an admixture of sawdust, or cocoanut fiber refuse, but with the penalty that the efficiency of the material is reduced, and the period of its active life limited.

In purchasing oxide, the ordinary common sense gas manager can estimate the ratio between the price of the material and its probable efficiency, based on an accurate analysis. A specification for purchase which I recommended some years back, and which was adopted by a large gas company, was as follows:

Not exceeding 50 per cent. of water.
Not exceeding 2 per cent. of siliceous matter.
Not less than 60 per cent. of Fe_2O_3, on the dry basis.

A typical example of good Irish bog ore gave the following results on analysis:

Moisture per cent.	45.2
Siliceous matter	2 0
Organic matter and combined water	19.5
Oxide of iron, Fe_2O_3	33.0
	99 7

Percentage of F_2O_3 on the dry basis = 60.2.

Though the usual method of analysis of bog ore is probably well known, it may not possibly be without interest to describe the process which I have adopted for many years. Where a large number of samples have to be dealt with, there is no doubt that a volumetric method for the determination of ferric oxide would save a considerable amount of time.

The ordinary process is, however, as follows: A weighed quantity of the sample is dried at 212° F. The loss is registered as "water" or "moisture." The residue is then ignited, and the loss registered as "organic matter and combined water." The ignited residue is next digested in strong hydrochloric acid, with the addition of a few drops of nitric acid, until all the ferric oxide has been dissolved—judged by the insoluble matter being free from any red color. The solution is then diluted and filtered, the insoluble residue, after complete washing being ignited and weighed. A portion of the filtrate is precipitated with ammonia, and the precipitate washed with hot water and ignited and weighed. The ignition should be made with a cover over the crucible as during the transition of the ferric hydrate to anhydrous ferric oxide, what is termed "decrepitation" takes place. This means that a pro portion of the precipitate which should be weighed is projected and lost.

It is sometimes a practice to precipitate the ferric oxide in hot solution with excess of sodium hydrate, with the view of eliminating any alumina present. If this course of procedure is adopted, the precipitated ferric hydrate should be dissolved in dilute hydrochloric acid and reprecipitated with ammonia. This precaution is most necessary, as it is almost impossible to thoroughly wash the precipitated oxide free from soda. Basic salts are formed, which are not entirely decomposed by hot water; and an error might thus arise, giving an exaggerated proportion of ferric oxide in the sample tested. I have never found a weighable proportion of alumina present in samples of bog ore; and I therefore always adopt the method of precipitation by ammonia in preference to the use of soda.

There is one question over the valuation of bog ore for gas purification purposes which has been under my consideration for some considerable time. That is the question of what is the real composition of hydrated oxide of iron. The question is one of serious commercial importance. I was consulted a short time back by a Continental firm, who guaranteed a certain percentage of hydrated oxide of iron. The consignment was to a gas company in this country. The Continental firm was under the impression that the formula for hydrated oxide of iron was Fe_2O_3, $3H_2O$; but the manager of the gas works insisted on the acceptance of the formula $Fe_2O_3H_2O$. This led to a dispute over which I had to arbitrate, and I made an investigation.

In the first place, it was necessary to ascertain what the composition of artificially prepared oxide should be. For this purpose, a solution of ferric chloride was treated with ammonia. The precipitated ferric hydrate, after a thorough washing with distilled water, was dried at 212° F. The loss on ignition amounted to 13.6 per cent. This fairly corresponds to a formula of $2Fe_2O_3$, $3H_2O$, which theoretically requires 14.4 per cent. of water. This seems to indicate two things. The one is that the claim of a formula of Fe_2O_3, $3H_2O$ is untenable, and the other is that the formula of $Fe_2O_3H_2O$ is equally untenable. A reference to Watt's "Dictionary of Chemistry" has afforded me the following information:

Composition of Artificial Oxide by Precipitation.

Fe_2O_3, $2H_2O$.
Fe_2O_3, $3H_2O$.
$2Fe_2O_3$, $3H_2O$.

Natural Oxides.

1. "Gothite," $F_2O_3H_2O$.
2. Limonite, $2Fe_2O_3$, $3H_2O$.
3. Xanthosideride, Fe_2O_3, $2H_2O$.
4. Bog ore from Russia, Fe_2O_3, $3H_2O$.

The percentages of water in the natural bog ores would come out as follows:

$Fe_2O_3H_2O$ = 10.1 per cent.
$2Fe_2O_3$, $2H_2O$ = 9.8 "
$2Fe_2O_3$, $3H_2O$ = 14.0 "
Fe_2O_3, $3H_2O$ = 24.5 "

The percentages of the various hydrates corresponding to 100 parts of Fe_2O_3 would be as follows:

For $Fe_2O_3H_2O$.....107.2
" $2Fe_2O_3$, $2H_2O$.....110.0
" $2Fe_2O_3$, $3H_2O$.....116.3
" Fe_2O_3, $3H_2O$.....132.5

Watt's "Dictionary of Chemistry" states that "ferric hydrate gives off part of its water between 80° and 100° C., and the whole at a red heat; it is also completely dehydrated by heating it to 160° to 200°, with a saturated solution of chloride of calcium or chloride of sodium."

I have made some experiments on natural bog ores dried over sulphuric acid in a desiccator until no further loss ensued, and subsequently exposed to a temperature of 212° F. In all cases there was a loss, proving that a hydrate existed which was at all events partially decomposed at a lower temperature than 212° F. Probably the hydrates were of different composition—some being unstable between the ordinary atmospheric temperature and 212° F., and others not decomposing until exposure to a temperature of over 212° F., the final decomposition possibly occurring at a low red heat. This, at all events, establishes the fact that hydrated ferric oxides exist in natural bog ores which have a higher percentage of combined water than is even represented by the formula of $2Fe_2O_3$, $3H_2O$.

This much is certain, that the restrictions over ordinary sulphur compounds being abrogated, gas companies are no longer bound to compulsorily remove carbon dioxide from their gas. This question is, therefore, now entirely optional. Where lime had to be used, a more or less proportion of sulphuretted hydrogen was removed by this material: but under present circumstances, the whole onus of the removal of sulphuretted hydrogen depends on the use of oxide of iron, and therefore the correct valuation of this material has become of increasing importance.

With regard to the spent material, after repeated use. The usual practice for valuation is to ascertain the percentage of moisture by drying at 212° F., and subsequently thoroughly exhaust the residue of free sulphur; the proportion of sulphur being ascertained by the evaporation of the solution. I have for some time past practiced a more expeditious method. Fill a 250 cc. flask, having a fairly long neck, with carbon disulphide; and then drop in 250 grains of the spent oxide previously dried. Shake up for a short period, and then start filtering. It takes but a few minutes to pass 100 cc. Without waiting for the whole filtrate to pass or to wash the residue, the 100 cc. (representing 100 grains of the sample) is evaporated, and the percentage of sulphur is at once ascertained in the smallest possible time.

The following example will show that my method is as accurate as it is simple:

Total exhaustion process—Sulphur per cent.....45.53
My process—Sulphur per cent.....45.50

I trust that this information will be of interest to your readers.

Is the Wiring Contractor Doomed?

By Mr. S. W. Wilkins, in *Electrical Review*.

The existing state of the electrical trade is one that affords much food for thought. A transition is happening before our eyes; a new order of things is coming. The past 20 years have witnessed the ruthless exploitation of the great wiring boom, in which fortunes have been made and large businesses built up. Now the trade is settling down to its normal proportions, and we are face to face with the fact that the past affords no indication of the future, and that with the end of the boom the trade has to be carried on under different circumstances entirely. The manufacturing houses can seek new fields abroad, and they have usually so many irons in the fire that dividends can be secured by the

elimination or neglect of the unprofitable lines to make room for the more remunerative branches. With the wiring contractor, however, matters are on a different footing. His business is confined within rigorous lines, and there is not usually any room for setting one branch of the business against another.

The wiring contractors' trade a few years ago was a very good one to those who knew their business. The advantages of electric lighting were apparent, and there was a splendid field among the classes to whom first cost was not a great matter, and who did not need to weigh too closely the relative rates for gas and the new illuminant. A large and profitable business was done in apparatus and fittings; new developments were constantly arising to give impetus to trade, and the whole industry prospered. The relations between the wholesale houses and the retailer were the same as those existing in other trades; the retailer was regarded as the necessary distributor of the manufacturer's goods, and the two branches worked in harmony and with mutual cooperation. From these halcyon days down to the present there have been influences at work which have completely changed the whole aspect of affairs. Keen competition has, of course, been the most potent of these influences, but it seems beyond dispute that over and above the ordinary incidences of trade fluctuations, the state of affairs in the past has been abnormal, and that the industry as a whole is now settling down into its groove. What is that groove to be? How are matters going to adjust themselves in the future?

One of the most noticeable features in this evolutionary process has been the disappearance of the mystery surrounding electricity. The man in the street has a very fair general notion of the eccentricities of "juice," and the enterprising ignoramus who has the temerity to inscribe "Electrical Engineer" over his doorway does not strike awe into the passer-by, and find himself regarded as a man of science. Under existing conditions, it is the easiest matter in the world to get together a staff of competent wiremen, if one knows how to go about it. The qualifications necessary to a man before he can undertake a wiring job are so comparatively small, and are possessed by so many, that the number of men willing to undertake such work is legion. Every contractor has his eye on the ever present danger of his right-hand man, after lying low for a few years, leaving his employer to start work for himself, but taking as much of the connection away as possible. It is certain that there can be no lasting stability about a business where such manœuvers are so easily practicable. The result is naturally a gradual process of devolution, the substitution of a horde of master wiremen for the old contracting firms. Such a state of things affords a most tempting bait to other partially allied trades. The builder, the ironmonger, the house decorator and jobber, and the stores, find little difficulty in annexing such electrical work as is going on in their neighborhood. The extra capital required is not great, the stock need be but small, the wholesale houses will give lowest trade terms for the asking, while good wiremen will besiege the doors for employment. Such is apparently the future of the electric wiring business. It must eventually be grafted on the other trades, it is not sufficient to stand by itself under normal conditions; and the above are the trades which are destined to work it. In all branches of electrical work requiring more than ordinary skill, and to which a great responsibility is attached, the manufacturers will invariably step in to do the work, either directly or indirectly. Practically all power installations are now taken by the makers of the machinery, and gradually all pretence of the intervention of a trade man is being dispensed with. Competition is so terribly severe in this class of business that if the manufacturers can only keep their factories going on full time regularly they esteem themselves fortunate. Profit is, of course, highly desirable, but not always obtainable nowadays in motors, and two profits are absolutely out of the question. The same remarks apply in a lesser degree to the general sale of electrical material. Most articles for use with the electric current are fairly costly, and the purchaser will only buy from a firm of good standing and repute—the maker, if he can ascertain who the maker is. Competition is driving the makers to encourage this class of business, and by degrees the contractor is being eliminated. The process is facilitated by the growth of the small man, who is willing to wire up customers' own goods—a thing which the contractor of the old days would have scorned to do without his discount.

The combination of circumstances against the contractor is deeply to be regretted by the trade as a whole. To this cause is attributable the vast amount of shoddy work now being done, with the inevitable ultimate consequence of bringing a certain amount of odium upon electric work in the public eye. Fires, leakages, short circuits, constantly blowing fuses, and all the usual accompaniment of faulty wiring, have been very much in evidence of late, as anyone who has had much to do with installation inspection can testify. This, coupled with the growing awakening of the public to the undoubted costliness of electricity at present rates, and the remarkable recrudescence of energy on the part of the gas companies, has had the effect of giving a decided set back to the progress of electric lighting.

In the wholesale and manufacturers' side of the business, the trend of events has effected similar changes, though not with similar results. Competition has become very keen, prices are very low and profit small. New firms of comparatively small capital have sprung up in all directions, either for manufacturing and specializing in one particular class of goods, or for factoring foreign articles. Competition and the decline of the general contractor are gradually compelling all wholesale houses to treat with the general public. They are being loudly blamed for this, but it is not due so much to faulty policy on their part as to the inevitable march of events. In the absence of a strong and prosperous army of retailers to act as the distributors of their goods, the manufacturers must necessarily take on such distribution themselves. Needless to say, they do not wish to do it, as they usually have no machinery for this class of business, but they must look ahead and make provision for the future from a natural instinct of self-preservation.

The attempt on the part of the municipalities to get powers to supply goods through the medium of their generating stations is a sign of the times. With the central stations equipped with showrooms and a commercial department, the electrical trade would be on a level with the gas companies. However one may be opposed to municipal trading, there is something to be said for the promoters of the scheme. The general public have now very few opportunities to inspect the latest things in electrical apparatus; the ignorance of the man in the street regarding the various articles now available for use with the current is remarkable. In short, electrical goods for use on the ordinary house supply are not being pushed. The contractor apparently cannot do so; therefore either the central stations or the manufacturers must do it. The Municipal Supply Bill is a step towards the former; the forthcoming great exhibition at Olympia is a step towards the latter. What will be the final result?

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

"La Compania de Gaz y Electricidad, which in the type of this part of America's possessions would seem to read The Gas and Electric Company, of Havana, Cuba, has elected Mr. E. G. Vaughan, President of the National Bank of Cuba, as its President." So writes the Editor of the Havana *Post*. On his election Mr. Vaughan in time was interviewed by a committee of the Company's shareholders, who, having informed him of his election, asked for some outlining of his policy respecting the management (immediate or otherwise) of its affairs. His response was quite to the point. It sounded like this: "Gentlemen, my platform is better light first, and extensions of the service later."

We are informed that the Dublin Gas and Electric Company, of Dublin, Tex., has been incorporated by Messrs. J. F. Strickland and Oscar Goodwin, of Dallas, Tex.; M. B. Templeton, of Waxahachie, Tex.; R. B. Stichter, Sherman, Tex., and J. R. St. Clair, of Dublin. The Company is capitalized in $50,000. The names of the incorporators should be sufficient guarantee that the incorporation is not a blind one.

The quarterly dividend of 2 per cent. on the shares of the Consolidated Gas Company, of New York, is payable the 15th prox.

The following communication, from Boston, Mass., under date of the 5th inst., can be readily understood—in time, perhaps, other Companies will do likewise: "Mr. James Hammett, of the Consolidated Gas Company, of Boston, received this letter some days ago from Mr. J. L. Richards, its President: 'It affords me great pleasure to say to you, on the completion of your 53 years of loyal service to the Company, that your faithful services are duly appreciated, not only by myself but by the entire Board of Directors, and I beg to advise you that upon your retirement to-day from active service with the Company you have been placed on the retired list at the rate of $600 per year.' President Richards, on being asked by a reporter of the *Post* as to the noted action in the case of Mr. Hammett, replied: 'The Company has decided in future to pension all employees who have served the concern faithfully for a number of years. We take into consideration their wants and the size of their families and decide upon the amount that will make them comfortable for life. We have no fixed amount and no fixed time. For instance, we have a man now who has been ill for months and who might never recover, and he has not been in our employ for very many years. Still we are looking after him and shall continue to do so as long as he lives, no matter whether he is able to get back to work or not. All we require is faithful service and then we see the men are not forgotten in sickness or old age.'"

Those in charge of the gas supply of Seneca Falls and Waterloo, N. Y., have notified the residents that the gross selling rate is hereafter to rule at $1.60 per 1,000; prompt payment (within 10 days) to entitle the user to a rebate of 10 cents per 1,000.

MR. HUBERT SENGER will assume charge of the office force of the Port Jervis (N. Y.) Electric Light, Power, Gas and Street Railway Company, through virtue of his appointment to succeed Mr. Melchior Horn. The latter goes into the service of the Wahneta Silk Company, Catasauqua, Pa.

THE Gas and Electric Development Company, of Philadelphia, reports the sale, to a syndicate of Philadelphia and New York capitalists, of the plant and franchises of the Washington (N. J.) Electric Light Company, which concern heretofore was controlled by Washington residents. The purchasers are to remodel the plant, which will undoubtedly be better off, no matter what is done to it.

MR. FRANK P. VOGL, Treasurer of the Claremont (N. H.) Gas Light Company, announces that the $60,000 issue of 4 per cent. bonds on that property—the bonds are to live for 20 years from July 1, 1905, to July 1, 1925—have been taken. The Claremont Company is controlled by the owners of the Monadnock Mills. The bond trustee is the New England Trust Company, of Boston.

THE City Council, of Springfield, O., is inclined to ask and insist that the practice of charging meter rental by the local Gas Company shall be abolished. The City Solicitor has declared that the charge is by no means an equitable one; but, then, his knowledge of the conditions that actually govern the supply of gas in and to cities is not extensive.

THE Elkador (Ia.) Gas Company has been organized by Messrs. M. J. Poull, C. C Oehring, V. T. Price, J. F. Becker, Edward Hofer, M. J. Poull and Joseph Lamm. Mr. M. J. Poull is President of the Company.

THE Northern Gas Construction Company has awarded to Mr. F. D. Moses, of Trenton, N. J., the coutract for the building of a complete gas works at Austin, Minn. The President of the Austin corporation is Mr. T. J. H. Leckband.

A CORRESPONDENT in Louisville, Ky., forwards the following: "About a fortnight ago Judge Miller handed down an opinion declining to grant the temporary injunction asked for in the suit of Mr. George M. Boone against the Louisville Gas Company to prevent the latter from selling natural gas. Plaintiff sought to restrain defendant from piping gas from Meade county, and various allegations were made of the losses that would be sustained by the Company and consequently by the stockholders should such an enterprise be attempted. Judge Miller holds that if the defendant concern has a charter right to engage in the natural gas business, it is not in the jurisdiction of a court of equity to restrain that right, unless it is shown that the Directors are acting in bad faith. He also says that as there is no evidence or claim of fraud in the case, he can concern himself only with the question of whether the new enterprise is allowed by the charter or its amendments. He holds that the amendment of 1890 confers this right, by allowing the Company to buy stock in other companies. He further says that for him to attempt to decide questions of profit and loss for the directory, would be simply to make the Chancellor a Director in the Company, and to assume better knowledge of business policy than they possess. The injunction was denied."

THE Board of Gas and Electric Light Commissioners of Massachusetts has named the 21st inst. as the day for the hearing in the matter of the petition of certain residents of Natick for a revision of the rates charged by the local Gas Company.

WORK on the new gas plant for Gadsden, Ala., which is to be built by the Consolidated Light and Power Company, of Philadelphia, is well underway.

THE gas range, which was offered by the Birmingham (Ala.) Railway, Light and Power Company, for competition by vote at the recent State Fair, for award to the best housekeeper, was won by Mrs. John B. Reid.

THE State Commission of Gas and Electricity, having considered the complaint of Mayor Alan C. Fobes, of Syracuse, against the Syracuse (N. Y.) Lighting Company, has ordered service of the complaint on the latter. A time for the hearing will be duly announced. The complaint alleges inadequate service as to quality and price and the like. It is undoubtedly founded on political-financial reasons. Manager Cummins will be ready when the appointed time is at hand.

A CORRESPONDENT in Taunton, Mass., forwards the following, under date of the 5th inst.: "I have not seen any notice or mention in the JOURNAL respecting the new office quarters of the Taunton Gas Light Company, the desire of the proprietors to secure suitable featuring on such account having been formally completed the last week in October, when Secretary and Treasurer Walter T. Soper was a busy man receiving the throngs that accepted the Company's invitation to inspect the handsome home of the Company, 43 City Square. The work of remodelling the premises was performed under contract by Mr. L. M. Witherell. The Taunton *Gazette*, in referring to the completed office and showroom, says: 'The Company is to be congratulated on having obtained such excellent quarters, and there is no doubt but that the public will appreciate the same, with the result that there will be a noticeable increase in the business of this concern which has been associated with the commercial life of Taunton, with such an enviable record, for such a long term of years. The idea of the Company is to accommodate the public to the fullest extent, and to that end it will exert its every endeavor, being continually on the lookout for everything that can in any way tend to promote the welfare of its patronage. It will endeavor to carry every modern device known to the gas trade and every new invention that is out, and that is proved to be a good thing, will be found here. To be abreast of the times in everything and to push onward will be its constant aim. The Company has a competent force of men in its employ, and it is always intended that orders as fast as they are received shall have that prompt attention which is always desired, and people may rest assured that whatever work it undertakes will be faithfully and satisfactorily carried out. It is by such methods as these that it will aim to increase its patronage and bring its benefits to those who have not known them in the past, as well as to induce present users to extend their privileges.'"

AT the annual meeting of the Consumers' Gas Company, Toronto, Canada, the reports presented showed that the total receipts for gas rentals for the year amounted to $1,006,421.46, an increase of $100,562.83 over the preceding twelvemonth. Statistics covering the named items for the periods stated show:

Year.	Street Lamps.	Meters In Use.	Gas Rentals.
1903.....	944	33,677	$855,522
1904.....	984	36,428	906,858
1905 1,002		39,711	1,006,421

The net outcome from operating was $412,252, as against $263,348 in 1904, an increase of $143,904. Interest on debentures brought in $3,941 making a total value of $416,193. Dividends required $219,927, an increase of $28,776; $170,891 was transferred to renewal fund and $20,459 profit went to reserve fund. The output of gas for the past year amounted to 1,374,114,000 cubic feet, being 141,153,000 over that of the previous year. During the year nearly 12 miles of new mains have been laid, making the total mileage 302, and 3,400 new services have been put in. The 3,000,000 cubic foot gasholder, it is expected, will be finished before the winter sets in, and will afford ample storage room for the rapidly increasing production of gas. The plant and buildings renewal fund on October 1, 1904, was $424,255; $185,623 was spent during the year on repairs and renewals, and $170,891 added to the fund from earnings, leaving the total on October 1, 1905, $409,522. The reserve fund totals $973,155.86 having increased $21,853 during the year. In presenting the report President G. R. R. Cockburn said in part: "Toronto used 200,000,000 feet more gas than Montreal, largely because the price here is 80 cents and there $1.20, and the population of Montreal is 60 per cent. more than that of Toronto. Had the price here been what it is in Montreal, the people of Toronto would have paid $500,000 more for gas last year than they did. At board meetings during the year the Mayor said he thought the time was near for a reduction in the price of gas. I would call attention to the fact that a reduction of 5 cents would mean a reduction of $60,000 in the income of the Company. I can say that as soon as we are in a position to safely effect a reduction, we will be happy to do so. It would be awkward, especially to small manufacturers, who calculate their profits partly on the basis of the cost of motive power, if the price of gas were reduced and it was afterwards found necessary to raise it again. I can assure the consumer that in the Mayor and Board of Control they have vigorous allies in pressing down the price of gas." General Manager and Treasurer Pearson, in his report for the year submitted the following interesting figures for comparing periods of 10 years:

Year.	Output, Cubic Feet	Meters in Use.	Mains, Miles.	Rate,
1855.....	22,000,000	1,119	23	$3.00
1865.....	38,014,000	1,188	41	3.00
1875.....	100,122,000	2,508	66	2.50
1885.....	273,484,000	6,778	126	1.25
1895.....	614,553,000	20,626	227	1.05
1905 1,374,114,000		39,711	302	.80

In the total period the per capita consumption increased from 302 cubic feet to 5,946 cubic feet. The Directors elected were: A. W. Austen, J. L. Blaikie, A. H. Campbell, Jr., W. M. Clark, George R. R. Cockburn, W. Francis, F. le M. Grissett, Jas. Henderson, Jno. Hoskin, Thomas Long, G. R. Osler and Andrew Smith. The Directors subsequently elected the following officers: President, George R. R. Cockburn; Vice President, J. L. Blaikie; Secretary, Treasurer and General Manager, W. H. Pearson; Superintendent of Works, W. H. Pearson, Jr.

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NOTIFICATION RESPECTING ADVERTISING.

Orders for new advertising, or for changes in standing advertisements, to insure attention in the issue following their reception, must be in hand any time of Wednesday.

AGENTS:

New York—American News Co., 39 and 41 Chambers St.
Germany—Lemcke & Buechner, of New York.
England—Aug. Siegle, 30 Lime Street, London.

MONDAY, NOVEMBER 13, 1905.

The Market for Gas Securities.

There is little to say respecting the gas share market that might be considered novel. The weakness in Consolidated is not to be accounted for on any other basis than that of speculation, pure and simple. The price of Brooklyn Union is very low, even with a selling rate of 75 cents per 1,000 given undue consideration.

Peoples, of Chicago, is 102¾ to 103, and old Baltimore Consolidated is very cheap at the reported asking price, 87¼.

Gas Stocks.

Quotations by George W. Otese, Broker and Dealer in Gas Stocks.
16 WALL STREET, NEW YORK CITY.
NOVEMBER 6.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	Capital.	Par.	Bid.	Asked.
Consolidated	$78,177,000	100	179	180
Central Union, Bonds, 5's	3,000,000	1,000	108	110
Equitable Bonds, 6's	1,000,000	1,000	..	10[illegible]
" 1st Con. 5's	2,300,000	1 000	118	120
Mutual	3,500,000	100	275	290
Municipal Bonds	750,000	..	..	..
New Amsterdam Gas Co. ..				
Bonds, 5's	11,000,000	1,000	111	114
New York & Richmond Gas Co. (Staten Island)	1,500,000	100	37	41
1st Mtg. Gold Bds. 5 p. ct.	1,000,000	..	98	104
Northern Union, Bonds, 5's.	1,250,000	1,000	105	107
New York and East River..				
Bonds 1st 5's	3,500,000	1,000	112	114
" 1st Con. 5's	1,500,000	..	106¼	108¼
Standard	5,000,000	100	140	160
Preferred	5,000,000	100	155	175
Bonds, 1st Mortgage, 5's	1,500,000	1,000	111	114
Yonkers	299,650	500	130	..
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	120	120
" " Bonds (5's)	15 000,000	1,000	113	115
Bay State	50,000,000	50	3/16	¼
" income Bonds	2,000,000	1,000	..	75
Binghamton Gas Works	450,000	100	..	65
" 1st Mtg. 5's	509,000	1,000	95	100
Boston United Gas Co.—				
1st Series S. F. Trust	7,000,000	1,000	82	85
2d " " "	3,000.000	1,000	47¼	50
Buffalo City Gas Co.	5,500,000	100	10	12
Bonds, 5's	5,250,000	1,000	75	80
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000	..	..
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	104¼
Cincinnati Gas and Electric Co	29,500,000	100	106	106½
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,500,000	1,000	90	
Columbus (O.) Gas Lt. & Heating Co	1,682,750	100	..	95
Preferred	3,026,500	100	107½	108
Consumers, Toronto	,000,000	50	200	204
Consolidated, Baltimore	11,000,000	100	85¼	87¼
Mortgage, 6's	3,600,000	..	..	118
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490 000	..	..	112
Consolidated Gas Co. of N. J.	1,000,000	100	15	17
" Con. Mtg. 5's	880,000	1,000	92	95
Bonds	75,000	..	..	100
Detroit City Gas Co	4,825,500	50	..	50
" Prior Lien 5's	5,603,000	1,000	..	98
Detroit Gas Co., 5's	381,000	1,000	75	80
" Inc. 5's	16,000	100	98½	100
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Essex and Hudson Gas Co.	6,500,000	..	39	40
For Wayne	2,000,000	..	..	..
" Bonds	2,000,000	..	55	..
Grand Rapids Gas Lt. Co. 1st Mtg. 5's	1,925,000	1,000	104½	105
Hartford	750,000	25	190	200
Hudson County Gas Co., of New Jersey	10,500,000	..	110	112
" Bonds, 5's	10,500,000	..	110	110¼
Indianapolis	2,000,000	..	60	70
" Bonds, 5's	2,650,000	..	104½	105
Jackson Gas Co	250,000	50	82	..
" 1st Mtg. 5's	290,000	1,000	97	100
Kansas City Gas Light Co., of Missouri	5,000,000	100	..	36
Bonds, 1st 5's	3,822,000	1,000	102	104
Laclede, St. Louis	10,000,000	100	.	
Preferred	2,500,000	100	95	110
Bonds	10,000,000	1,000	108½	109
Lafayette Gas Co., Ind	1,000,000	100	..	60
Bonds	1 000,004	1,000	60	65
Louisville	4,570,000	50	143	145
Madison Gas & Elec. Co.				
" 1st Mtg. 6's	350,000	1,000	106	108¾
" 6 per cent. scrip, due 1910	100,000	25	85	87
Montreal, Canada	2,000,000	100	218	218¾
Nashville Gas Lt. Co	1,000,000	100	110	..
Newark, N. J., Con. Gas Co.	6,000,000	..	56	58
Bonds, 6's	4,600,000	..	137	138
New Haven	2,000,000	25	200	..
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	102¾	103
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	30,100,000	1,000	..	.
2d "	2,500,000	1,000	104	
Rochester Gas & Elec. Co.	2,150,000	50	88	..
Preferred	2,150,000	50	118	..
Consolidated 5's	2,000,000		101¼	1 5½
San Francisco, Cal.	15,800,000	100	58¼	58⅝
St. Joseph Gas Co.				
" 1st Mtg. 5's	751,000	1,000	92	..
St. Paul Gas Light Co	1,500,000	100	45	47
1st Mortgage 6's	650,000	1,000	113	116
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General Mortgage, 5's	2,465,000	1,000	96¼	..
Syracuse, N. Y.	1,975,000	100	50	55
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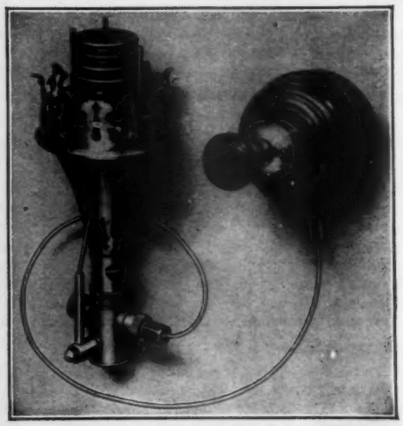

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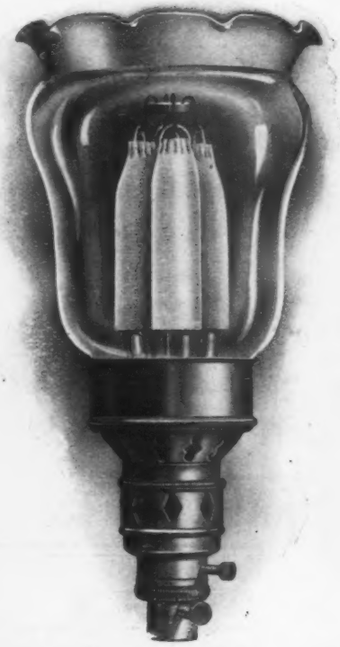

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A WORD TO THE GAS PRODUCER.

EVERY producer wants his goods to show at their best.

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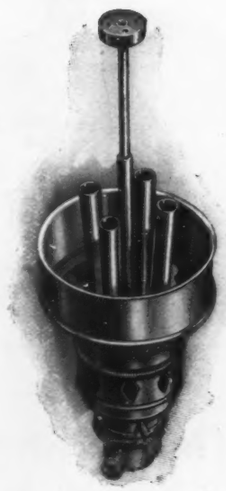

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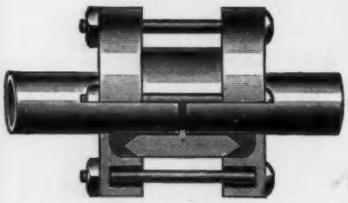
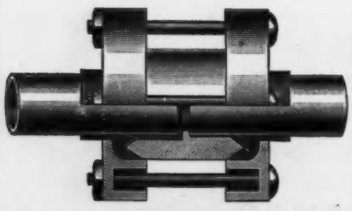


Regular Coupling, Style 1, for Plain End Wrought Iron Pipe.



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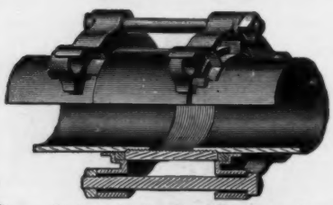

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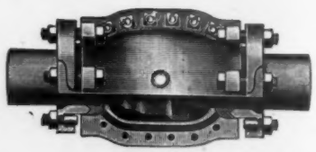
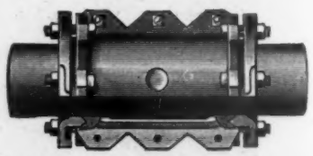


Split Sleeve for Repairing Broken Bell on Cast Iron Pipe.



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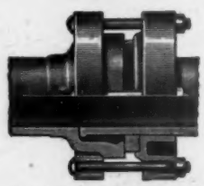

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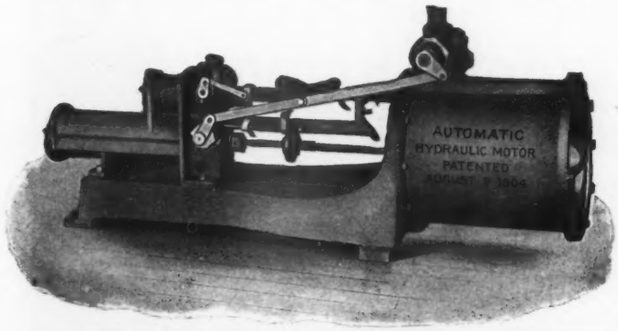

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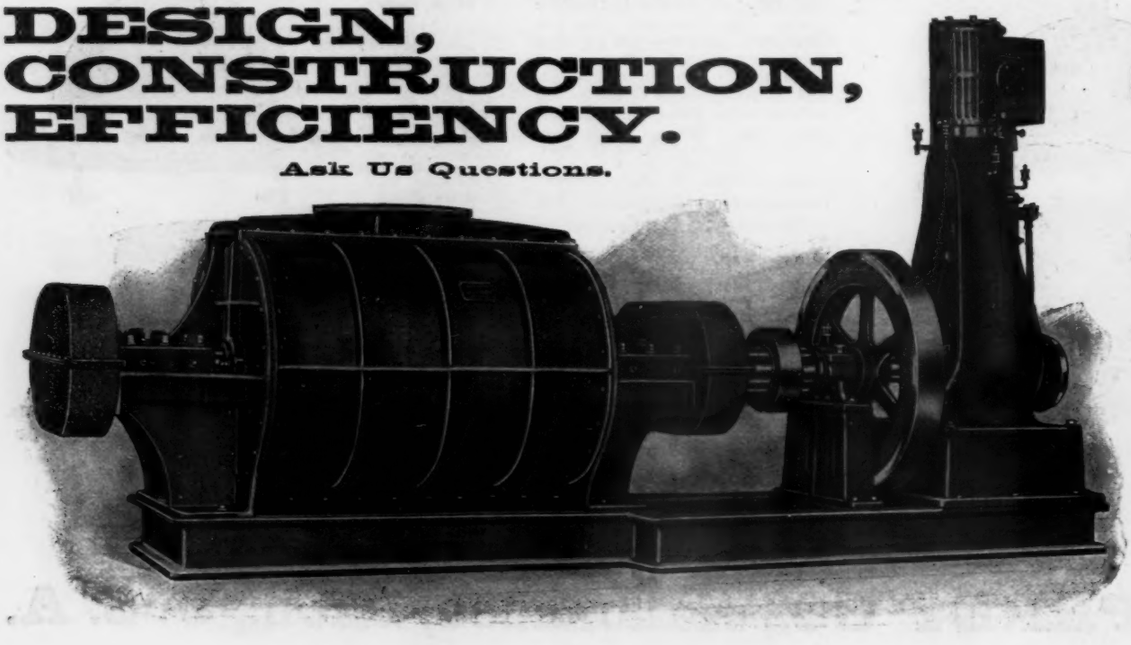

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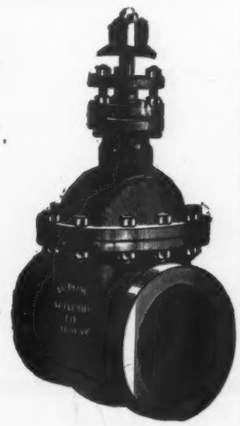

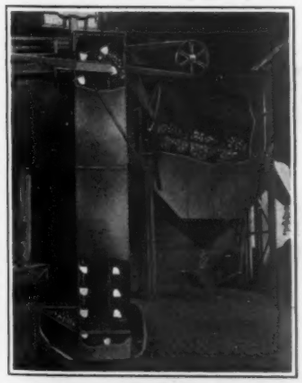

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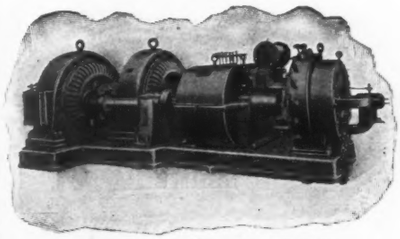

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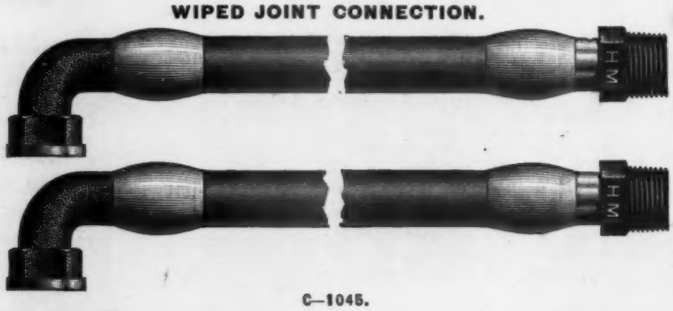

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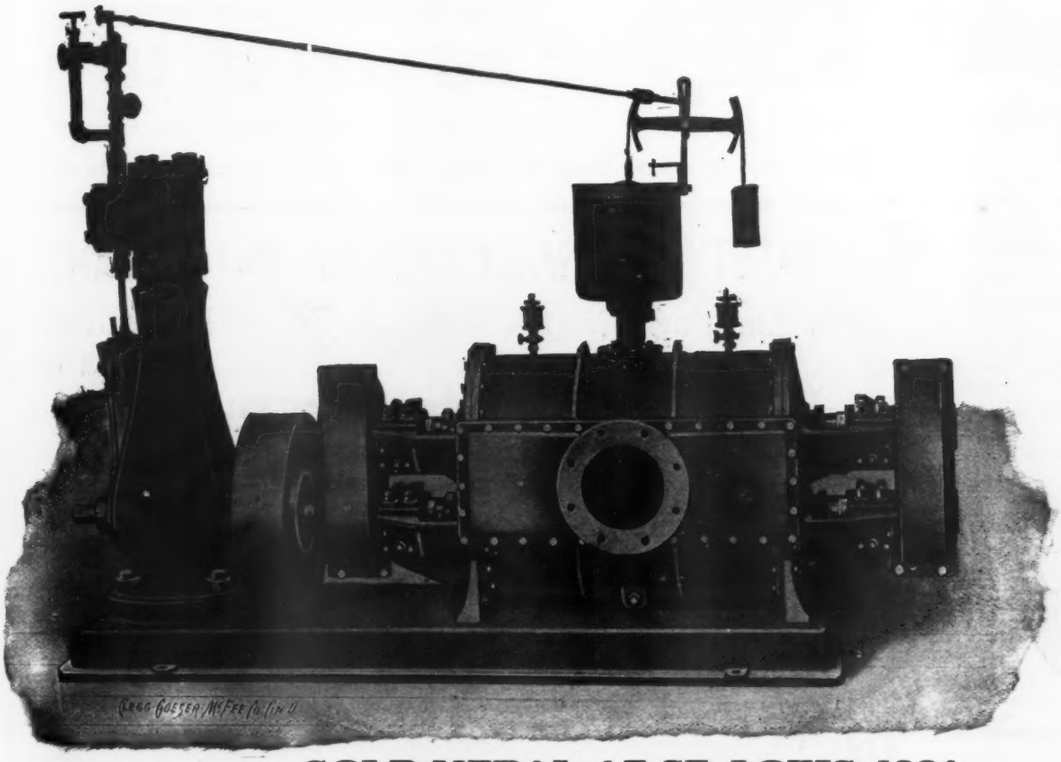

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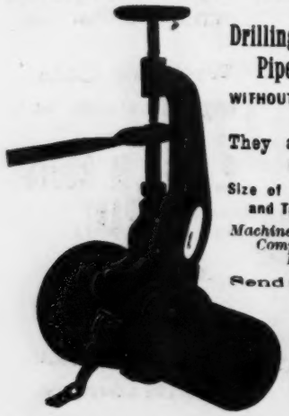

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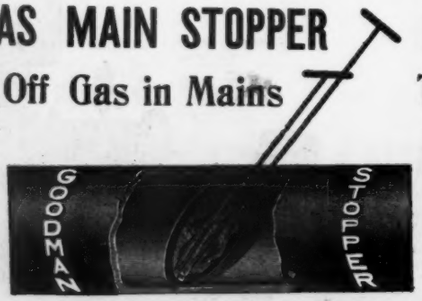

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PUBLIC LIGHTING TABLE.

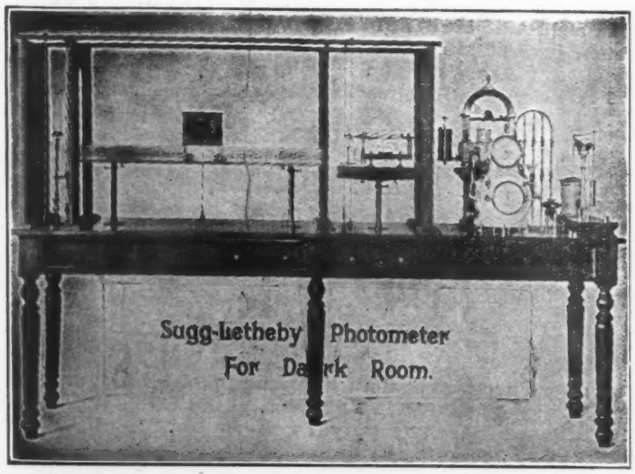
NOVEMBER, 1905.

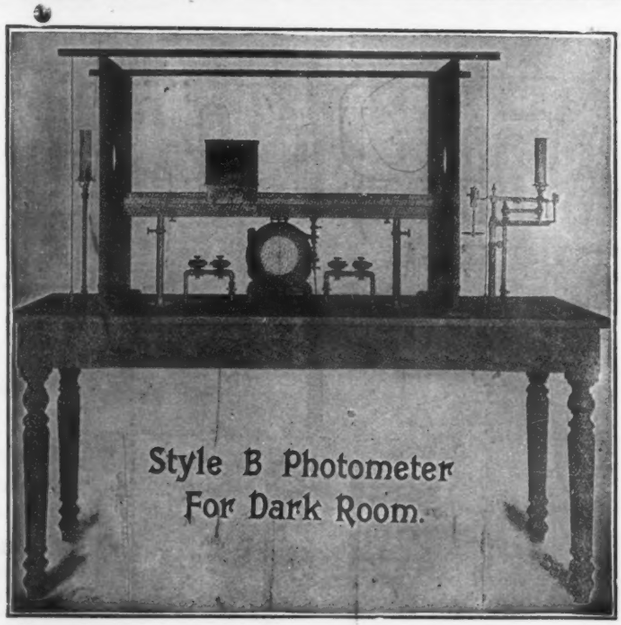
Day of Week.	Date.	Table No. 1. FOLLOWING THE MOON. Light.	Extinguish.
Wed.	1	8.10 PM	5.30 AM
Thu.	2	9.10	5.30
Fri.	3	10.10 FQ	5.30
Sat.	4	11.10	5.30
Sun.	5	12.10 AM	5.40
Mon.	6	1.10	5.40
Tue.	7	2.00	5.40
Wed.	8	3.00	5.40
Thu.	9	4.00	5.40
Fri.	10	No L.	No L.
Sat.	11	No L. FM	No L.
Sun	12	No L.	No L.
Mon.	13	5.10 PM	7.10 PM
Tue.	14	5.10	7.50
Wed.	15	5.10	8.30
Thu.	16	5.10	9.30
Fri.	17	5.10	10.20
Sat.	18	5.10	11.20
Sun.	19	5.10 LQ	12.30 AM
Mon.	20	5.10	1.30
Tue.	21	5.10	2.40
Wed.	22	5.10	3.50
Thu.	23	5.10	5.50
Fri.	24	5.10	5.50
Sat.	25	5.10	5.50
Sun.	26	5.10 NM	6.00
Mon.	27	5.10	6.00
Tue.	28	5.10	6.00
Wed.	29	5.10	6.00
Thu.	30	5.10	6.00

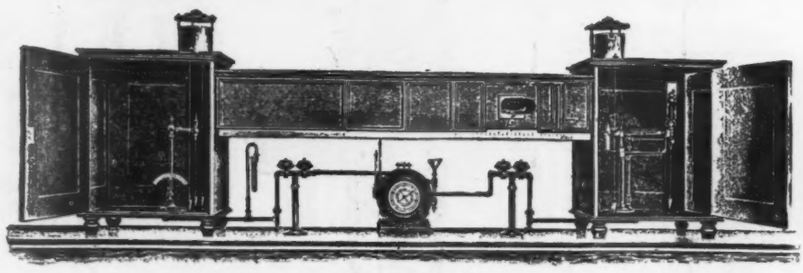
TOTAL HOURS DURING 1905.

By Table No. 1.

	Hrs.Min.
January	240.50
February	192.20
March	207.00
April	175.10
May	161.00
June	139.50
July	149.00
August	161.50
September	173.00
October	205.00
November	211.00
December	229.00
Total, yr.	2245.00







Closed Photometer For Light Room.

CIRCULARS SENT ON REQUEST.

PUBLIC LIGHTING TABLE.

NOVEMBER, 1905.

Day of Week.	Date.	Table No. 2. NEW YORK CITY. All Night Lighting. Light.	Extinguish.
		P. M.	A.M.
Wed.	1	4.45	5.35
Thu.	2	4.45	5.35
Fri.	3	4.45	5.35
Sat.	4	4.45	5.35
Sun.	5	4.40	5.45
Mon.	6	4.40	5.45
Tue.	7	4.40	5.45
Wed.	8	4.40	5.45
Thu.	9	4.40	5.45
Fri.	10	4.40	5.45
Sat.	11	4.40	5.45
Sun.	12	4.30	6.00
Mon.	13	4.30	6.00
Tue.	14	4.30	6.00
Wed.	15	4.30	6.00
Thu.	16	4.30	6.00
Fri.	17	4.30	6.00
Sat.	18	4.30	6.00
Sun.	19	4.25	6.00
Mon.	20	4.25	6.00
Tue.	21	4.25	6.00
Wed.	22	4.25	6.00
Thu.	23	4.25	6.00
Fri.	24	4.25	6.00
Sat.	25	4.25	6.00
Sun.	26	4.20	6.10
Mon.	27	4.20	6.10
Tue.	28	4.20	6.10
Wed.	29	4.20	6.10
Thu.	30	4.20	6.10

TOTAL HOURS DURING 1905.

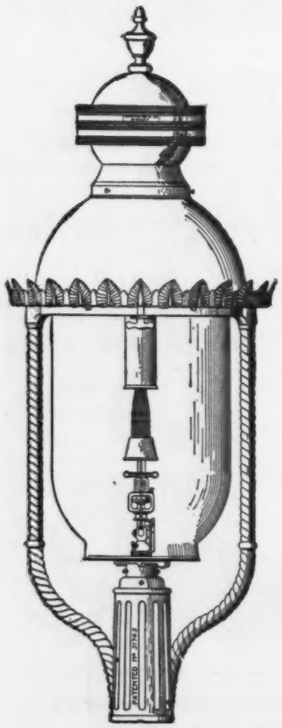
By Table No. 2.

	Hrs.Min.
January	423.20
February	355.25
March	355.35
April	298.50
May	264.50
June	234.25
July	243.45
August	280.25
September	321.15
October	374.30
November	401.40
December	433.45
Total, yr.	3987.25

NEW YORK, 97 Liberty Street. BOSTON, 814 Beacon Building. PHILADELPHIA, Broad and Arch Streets. ST. LOUIS, 712 Ree Building. CHICAGO, Foot of Orleans Street. SAN FRANCISCO, 712 Polk Street.

WELSBACH STREET LIGHTING COMPANY

.... OF AMERICA ....



No. 36.

Controls and Operates the

Welsbach System of Street Lighting,

Which includes its specially DESIGNED AND PATENTED BURNER for STREET and PARK LIGHTING exclusively.

Uniformly SUCCESSFUL in 150 Cities and Towns.

By means of the Welsbach System of street lighting the superiority of GAS over electricity for street lighting has been fully demonstrated.

POINTS OF MERIT:

It is { Economical, Attractive, Successful, Up-to-date.

IT LIGHTS THE STREET.

Where there are no gas mains we can furnish an equally good light by our SELF-GENERATING NAPHTHA WELSBACH BURNER, and thereby supply a uniform light in all localities.

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The Welsbach No. 6 Harp Fixture.

AN IDEAL LIGHT FOR DINING OR LIVING ROOMS.

THE HIGHEST MECHANICAL INGENUITY COMBINED WITH ORNAMENTAL BEAUTY--THE NEWEST OUTPUT FROM THE WELSBACH FACTORIES.

Equipped with new model No. 66 high candle power Welsbach Burner.

Side Pilot By-pass Tube covered with refractory sleeve to prevent bending.

Fourteen-inch Opal Dome Shade.

Polished Brass Embossed Crown 2¼ inches high.

Length of Fixture, 30 inches.

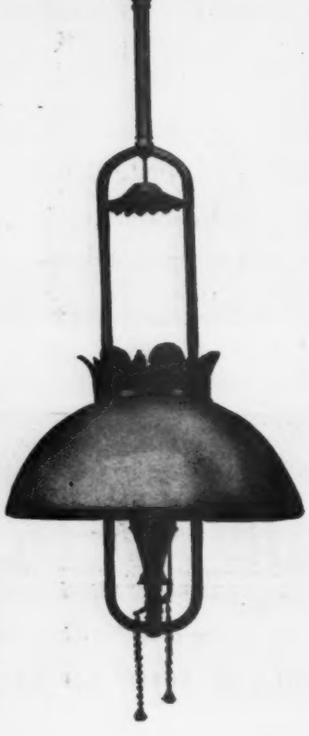
Width of Harp, 4½ inches.

Finished in Polished Brass.

Packed One Dozen to the Case.

List Price, per Dozen, $45.00.

We recommend equipping the No. 6 Harp Fixture with No. 4197 Intensive Brand Mantle, and the No. 306 **F. Q. M.** Clear Glass Air-Hole Cylinder.



Although the 14-inch Opal Dome Shade is standard equipment, we are prepared to furnish Dome Shades in green, pink or yellow (opal lined), and will be glad to quote prices.

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Salesrooms in all the principal cities of the United States.

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Detroit, Mich. (2d contract).	**New Britain, Conn.**	**Hamilton, O.** (2d contract).
Springfield, Ills.	**Ludington, Mich.**	**Indianapolis, Ind.** (2d contract).
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Pottsville, Pa. (2d contract).	**St. Louis, Mo.** (4th contract).	**Mahanoy City, Pa.**
Evansville, Ind. (2d contract).	**Sioux City, Ia.** (3d contract).	**Nanticoke, Pa.**

TOTAL SETS TO JULY 1ST, 1905, ... 585
TOTAL DAILY CAPACITY TO JULY 1ST, 1905, . 455,980,000 CU. FT.

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Established 1858. Incorporated 1890.
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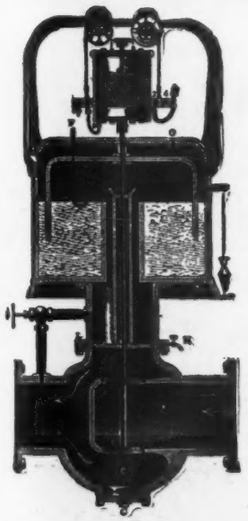

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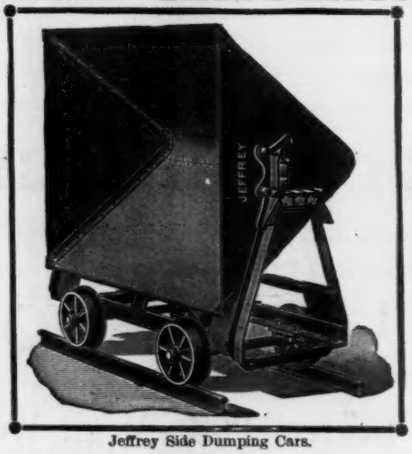

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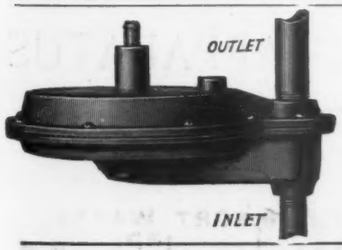

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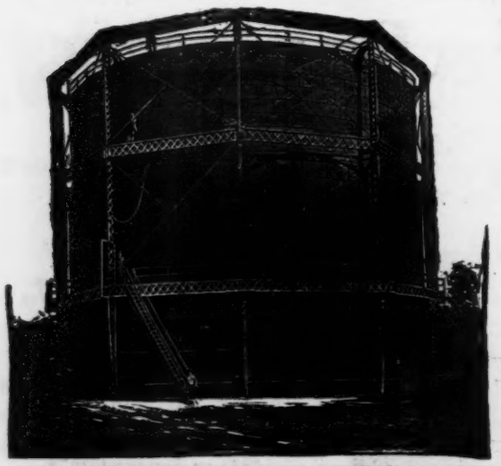

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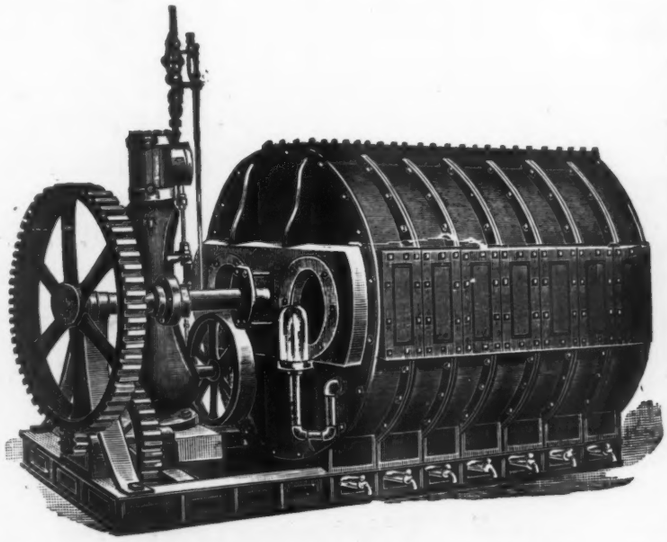

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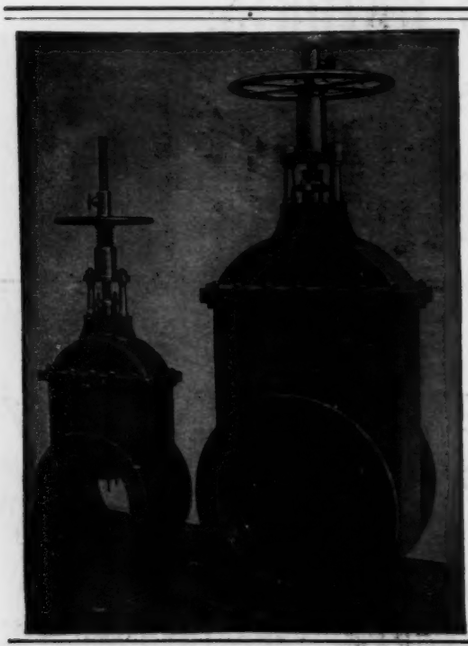

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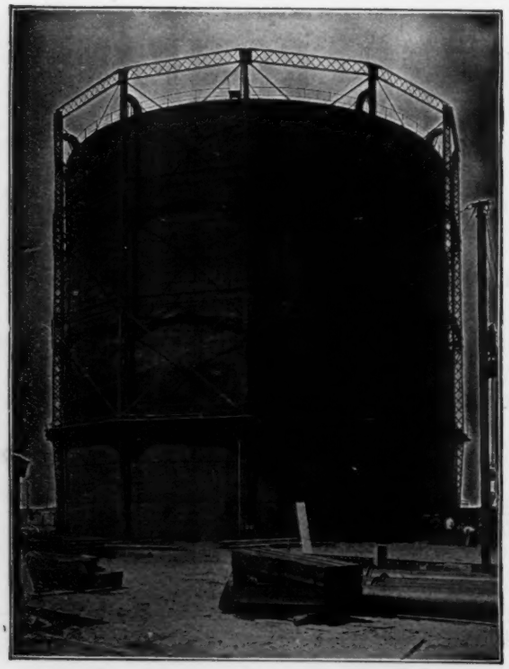

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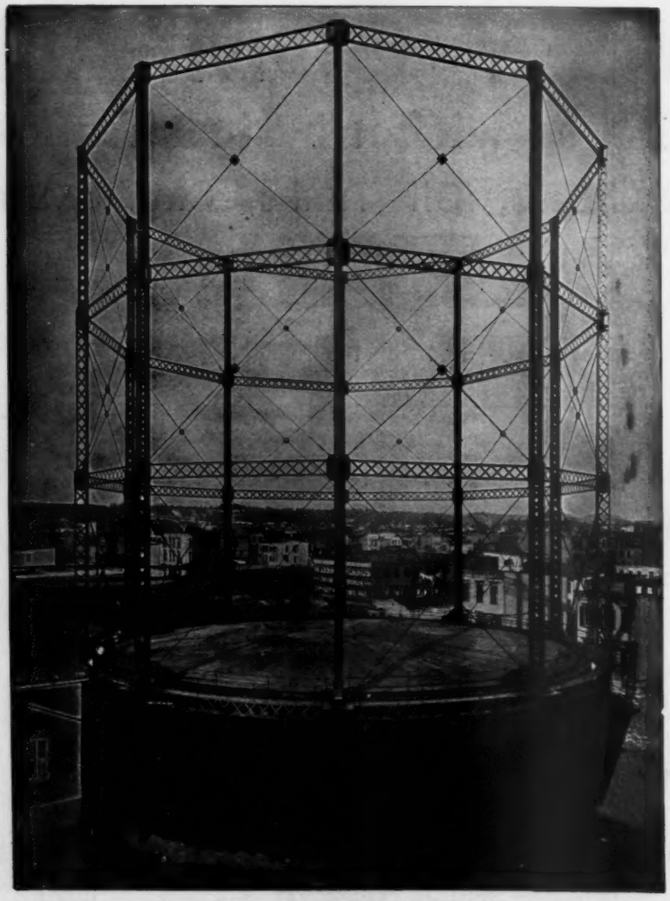

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